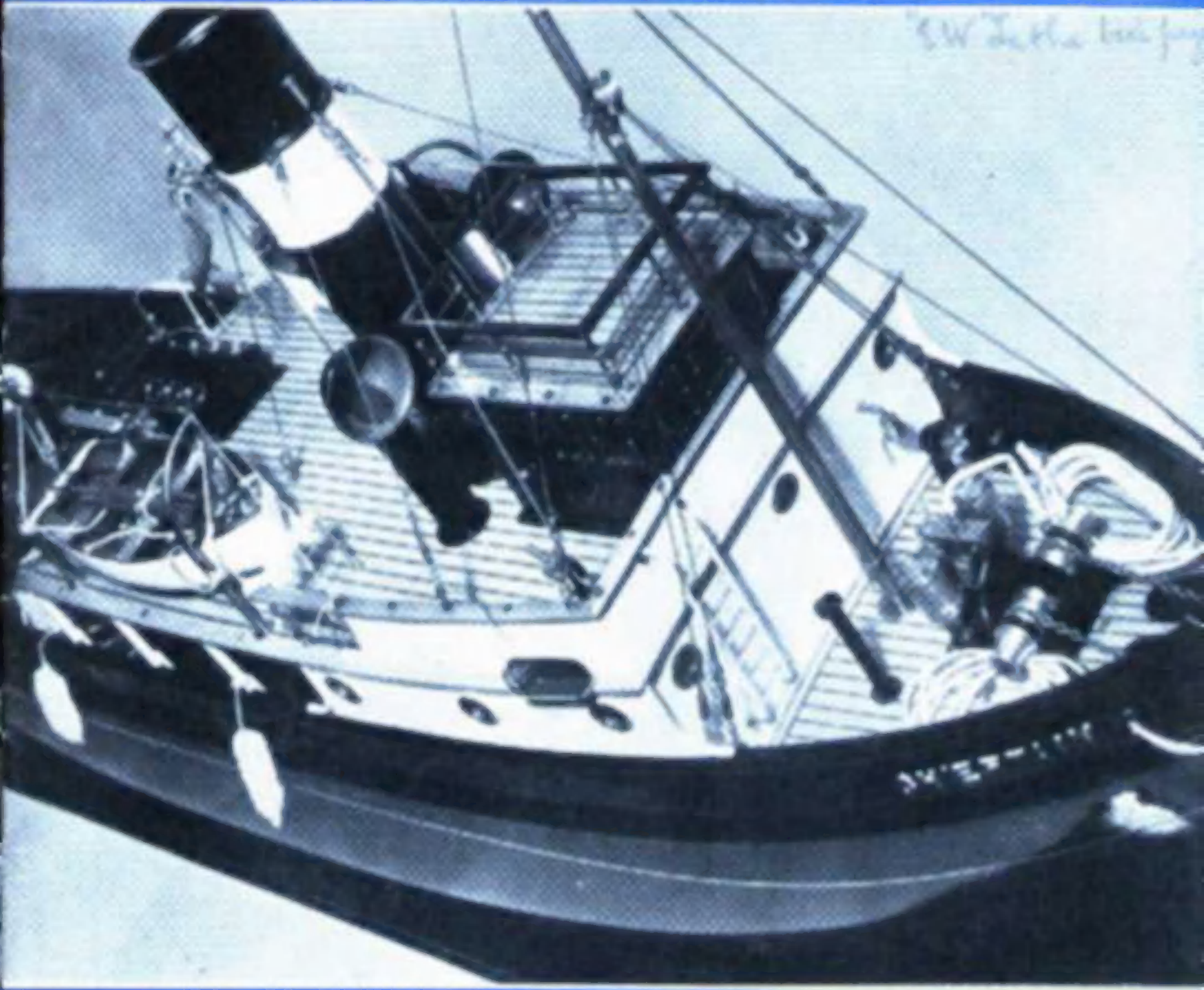
THE MODEL ENGINEER



IN THIS ISSUE

DECEMBER 24th 1953
Vol. 109 No. 2744

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THE MODEL ENGINEER

EVERY THURSDAY

Volume 109 - No. 2744

DECEMBER 24th - 1953

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET . LONDON · W · 1

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Our Cover Picture

In 1949, at the "M.E." Exhibition, Dr. J. Fletcher, of Colne, was awarded a Championship Cup for his model tug *Chieftain*. Our photograph, which was taken by "Northerner" at the recent Bradford Exhibition, shows some of the beautiful detail which helped to gain this award.

On the forecastle will be noted a working steam windlass. The rigging is complete with heart-shaped thimbles and bottle-screws, and the rails have correctly-shaped stanchions. The life-boats are properly slung from correct davits, and are fully fitted internally, including oars and boat-hooks.

The rope fenders and engine-room telegraphs look right, and so does the siren, which has an operating-cord to either wing of the bridge.

Detail not seen on the photo is done just as well, including the anchors, towing-hooks, and stern-grating. And, moreover, the engine-room is as good as the rest of the boat!

SMOKE RINGS

Wright Brothers Jubilee Exhibition

A SPECIAL exhibition commemorating the 50th anniversary of the first successful flight by the Wright aeroplane in 1903 is now open at the Science Museum, South Kensington.

Models, books, aeronautical relics and diagrams are displayed illustrating early contemporary thoughts and ideas on powered flight by a man-carrying machine; and how this was ultimately achieved by Wilbur and Orville Wright on December 17th, 1903. A series of sixteen large and, in some cases, dramatic photographs emphasise the many hazards faced by the early aeronautical pioneer. The exhibition will remain open for approximately three months. Admission is free.

Hours of opening: Weekdays, 10 a.m. to 6 p.m.; Sundays, 2.30 to 6 p.m. The Museum will be closed on Christmas Day.

Model Motor-cycle Competition

AS NOTED in an article on the recent Motor Cycle Show, in this issue, a model-making competition has been organised by the Auto-Cycle Union, 83, Pall Mall, London, S.W.1. All entries and correspondence in connection with the competition should be addressed to The Secretary, marking the envelope "Model Competition." It is a condition of entry that all models may, at the discretion of the A.C.U., be placed on exhibition at that organisation's stand at the Motor Cycle Show, in November, 1954. There are three categories for models, as described in the reference to this matter on page 746.

Models submitted should be accurate in appearance but need not be actual scale models. The total length should not exceed 10 in., No part of a model need be working, or capable of movement, but in all other respects they should faithfully represent the original. Any medium may be used. The A.C.U. will be responsible for the safe custody of all models sent in and will return them immediately after the 1954 show. An insurance policy will be effected to cover models against loss or damage while in the possession of the A.C.U. Entries should be received at the offices of the Union not later than September 30th, 1954. The judges will be as follow: Prof. A. M. Low (Chairman of the A.C.U.), Messrs. H. Louis, Graham Walker, C. E. Allen, D. A. Brown, and H. O. Twitchen. Results will be announced on October 31st, 1954, and a copy of the results will be despatched on that date to all entrants.

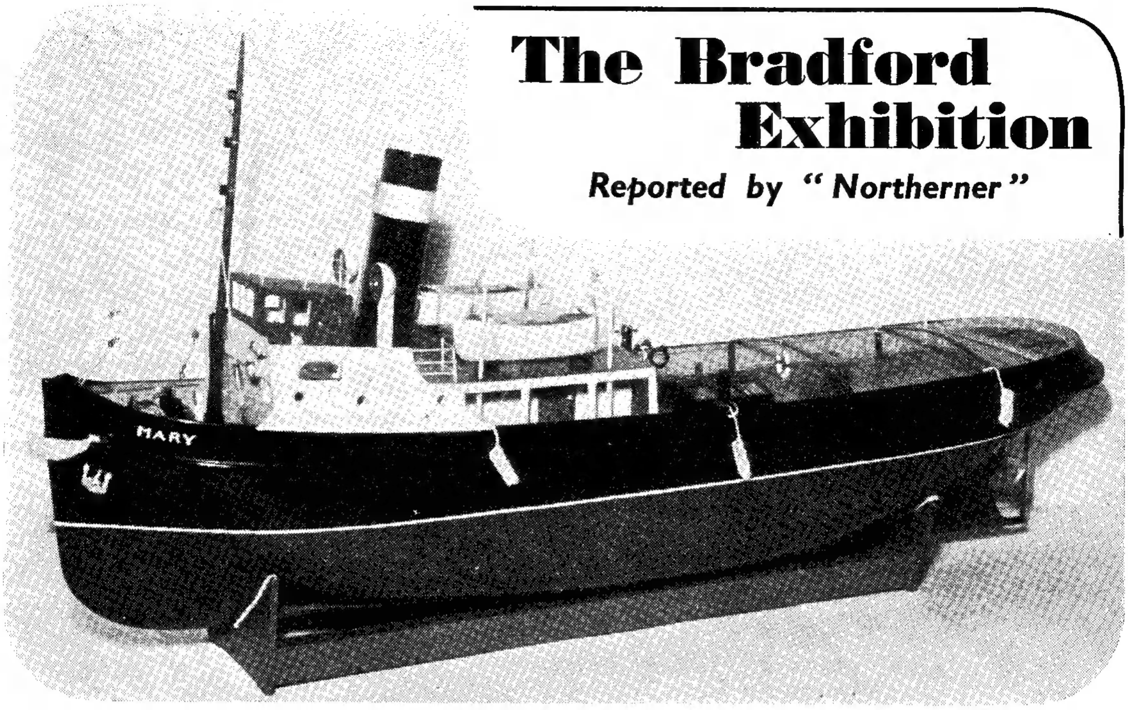
In each category the prizes for first, second and third places respectively will consist of £20 and an engraved souvenir plaque; £10; and £5. This is an entirely open competition and entries from overseas will be welcome, states Prof. Low.

It is suggested that competitors can obtain from the technical press photographs and other illustrations of the machine they may choose to model, or they can see prototypes in museums and in veteran motor-cycle collections of machines or photographs by applying to Mr. D. A. Brown, Registrar of Pioneer Records, 188, Green Lane, Morden, Surrey.

The Junior Institution of Engineers

AT THE recent annual general meeting of the Junior Institution of Engineers, the following officers were elected:

Chairman: S. G. Clark. Vice Chairmen: A. S. Ladley, M.Inst.Met. and J. H. Sharpe. Hon. Editor: W. N. Staton-Bevan. Hon. Treasurer: S. H. Hole, M.I.Mech.E. Hon. Librarian: J. A. Roberts. Councillors: C. Hunnikin, W. C. C. Ball, J. E. Gray and R. J. Herbert.



The Bradford Exhibition

Reported by "Northerner"

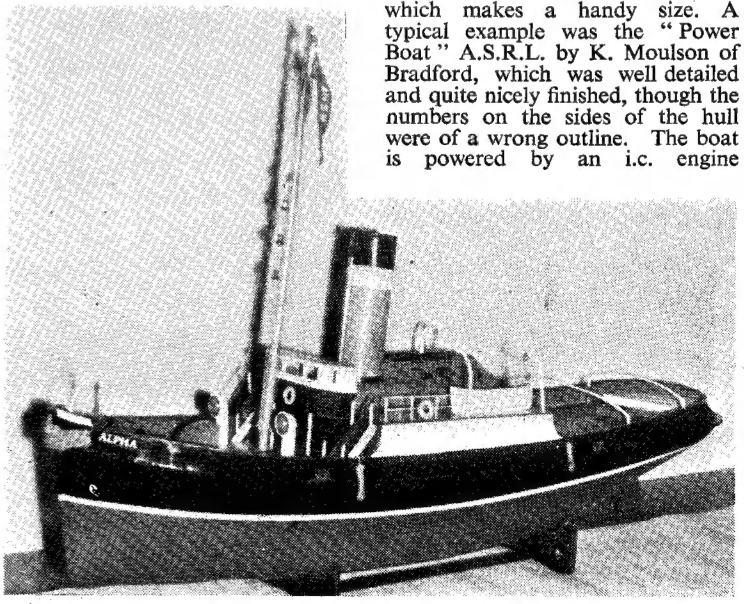
A model tug built by D. Holroyd of Spenborough, was only 25-in. long, and was electrically propelled.

NO matter what exhibition one visits, marine models and locomotives are usually the most numerous—in that order, too, as a rule—and this year's Bradford show was no exception.

Among the marine models the most outstanding was undoubtedly Dr. Fletcher's super-detailed "M.E." Championship Cup winner, the tug *Chieftain*, of which a close-up is given on the cover of this issue. The details include a lovely cable-windlass with twin oscillating cylinders, boats with oars and boathooks, rope fenders, anchors, towing-hooks, correctly made grating at the stern, and rigging with bottle-screws and correct heart-shaped thimbles. Truly a feast for any ship-lover !

A smaller tug-boat, built by D. Holroyd of Spenborough, was only 25 in. long, and was electrically propelled. It carried quite a bit of detail, including a nicely-made windlass, rope fenders, and so on, but the boats (carved from the solid) would have been better for carving much thinner. The stern grating too would be better if correctly made with the cross-slats level, instead of being raised.

Still another tug, steam driven and this time controlled by radio, was built by V. Brigg of Huddersfield. The hull, 4 ft. 4 in. long, was quite well finished, but that on the decks was not so good; the boats and windlass in particular could have done with more detail.



Another tug, which is steam-driven and radio-controlled. It was built by V. Brigg of Huddersfield

After seeming to become rather less common for a year or two, the wartime "light craft" appear to be regaining their popularity as prototypes, usually built to ½-in. scale, which makes a handy size. A typical example was the "Power Boat" A.S.R.L. by K. Moulson of Bradford, which was well detailed and quite nicely finished, though the numbers on the sides of the hull were of a wrong outline. The boat is powered by an i.c. engine

constructed by the builder. Incidentally, it was noticed that, like several other A.S.R.Ls seen lately, the fittings were made from articles published in this journal a few years ago.

Considering the fact that B. Rothwell of Huddersfield is only fifteen years of age, his unfinished model of the R.R.S. *Discovery* may be acclaimed as very good indeed. The finish was better than average (though I do not think that Capt. Scott's ship was ever painted in cream and green), and the vessel was fully rigged, though with simplified cordage. The model was built to drawings compiled from photographs and sketches of the prototype.

Some time ago, H. Brownless of Keighley started to build an inch-scale model of an Osborne cabin-cruiser, to succeed the Brooke Marine cruiser with which he won a "Bronze" in London. Unfortunately, the hull of the Osborne model was accidentally damaged beyond repair, and "Brownie" is now at work on a tug.

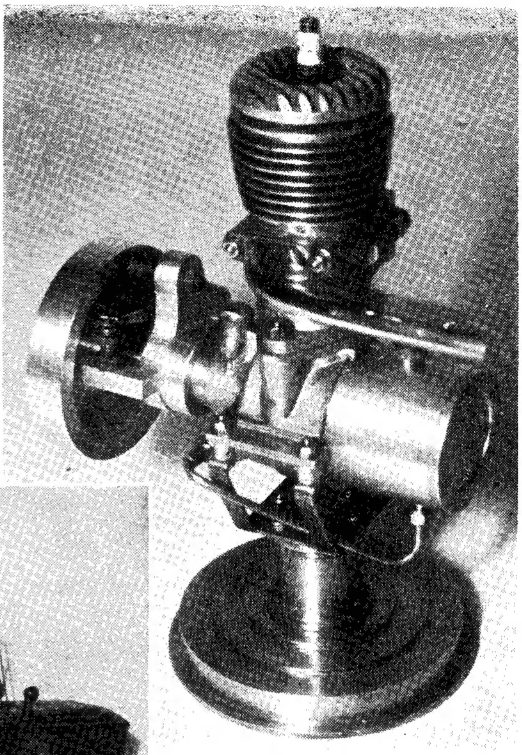
However, some excellent fittings, made for the cruiser, were on show at Bradford, one of them being the pulling dinghy. This is properly clinker-built, and is complete in all detail, giving a taste of what might have been had the whole model been completed.

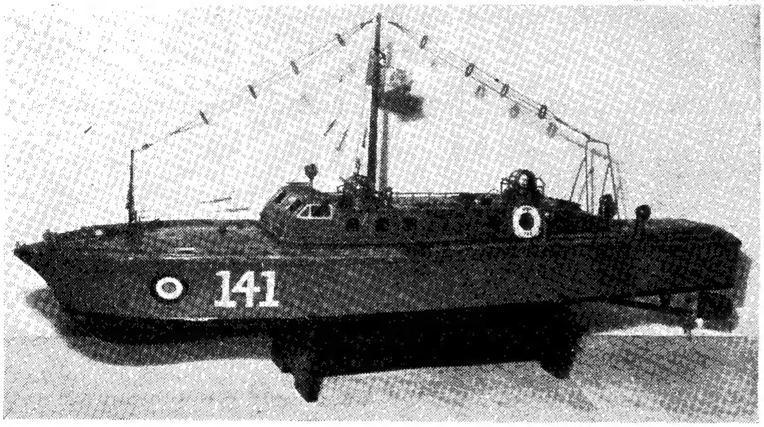
We had better postpone discussion of the locomotives until later, but I might mention two or three of the many other excellent models to be seen at Bradford.

First is a high-speed mill-engine built by Harry Booth, whose two-cylinder "fixed agricultural engine" was mentioned in one of my recent reports. The mill-engine had the usual superb finish which this builder always achieves, and was modelled on a handsome prototype built in 1896. Interesting points included a tail-rod to the piston, with cross-head and guide, and shaft drive to the governor, driven by skew-gears from the crankshaft.

We also had the pleasure of seeing others of Harry's models, including his beam engine of 1847 and compound horizontal mill-engine seen at the N.A.M.E. show a couple of years ago, and a "low" table engine of 1860. In addition, the twin-cylinder engine was at work under compressed-air, proving that she runs as well as she looks!

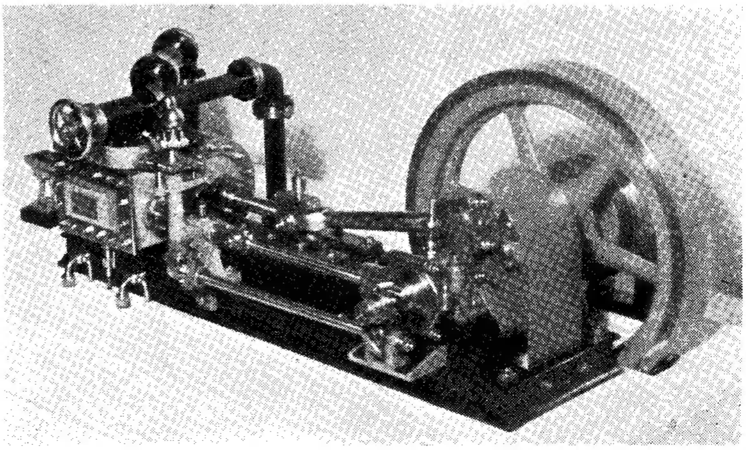
(*To be continued*)





(*Above*): *Among several models exhibited by H. Wood of Bradford was this 5 c.c. internal combustion engine*

(*Left*): *K. Moulson's "Power Boat" Air/Sea rescue launch, built to ½-in. scale, was very well-detailed*



Another of H. Booth's magnificent steam-engine models, a high-speed mill-engine of 2-in. stroke by perhaps 1¾-in. bore

BRITISH CRAMPTON LOCOMOTIVES

By E. W. TWINING

PART 8

THE next engines which will be dealt with are two constructed by Messrs. Kitson, Thompson and Hewitson of Leeds, for The Midland Railway. They were delivered in October, 1848 and were, therefore, contemporaneous with E. B. Wilson's batch of six, referred to in the last article; indeed delivery ante-dated the greater number of Wilson's lot for the Eastern Counties Railway.

Fortunately, certain drawings are in existence of the two Midland Cramptons; they were prepared by Kitsons and are now in the possession of South Kensington Science Museum. One of them, which shows valve-gear, is dated: January, 1848, some nine months before delivery; the second shows the reversing mechanism for the same gear, and a third, unfortunately undated, is a complete external side elevation of the engine. The omission of the date of the last is unfortunate because the drawing shows a portion of a valve-gear which is entirely different from that covered by the other, detail, drawings and were the complete elevation dated, it would provide very strong, if not conclusive evidence, as to which gear was fitted. In spite of the absence of date, however, the writer believes that the elevation is the later and for the reason which he will endeavour to explain.

In the first place, it should be said that the arrangement of the after part of these engines, which had return cranks carrying journals to be taken by outside axleboxes, was such that there was no space available for eccentrics outside of the driving wheels nor yet outside of the inside frames; for there were axleboxes in both inside and outside frames. It, therefore, appeared difficult to fit any of the—at that time—modern gears, and the writer believes that in the January, 1848 drawings an attempt was made to provide something which would overcome the difficulty.

The gear shown, though by no means complete, is Isaac Dodds's wedge motion which, patented in 1839, was obsolete by 1848; it was one which put great stresses on the reversing gear and was very complicated mechanically. There was one eccentric for each cylinder, mounted on a sliding sleeve carrying an oblique wedge, a pair of inclined planes, passing through the eccentric sheave; this wedge was at right-angles to the centre-line of the crank. The driver's gear lever moved the sleeve, and with it the inclined surfaces of the wedge, longitudinally along the axle and so caused the eccentric to take up positions either in advance of or behind the crank-line, or any intermediate position for expansive working of the valve. As a matter of fact, one sleeve only was fitted and this carried both the wedges, at ninety degrees to each other for right-hand and left-hand eccentrics, which, although revolving, had to be held literally in order to prevent the tendency to slide on their wedges. This, combined with the complication of shifting the sleeve by means of a reversing lever moving in a plane entirely different from that of the sleeve movement, made the whole gear mechanically inefficient. But the writer believes that the making of the drawing of Dodds' gear revealed, by a natural train of thought and ideas, a way by which it would be possible to fit a link motion, using two eccentrics and an ordinary expansion link together with a rocking

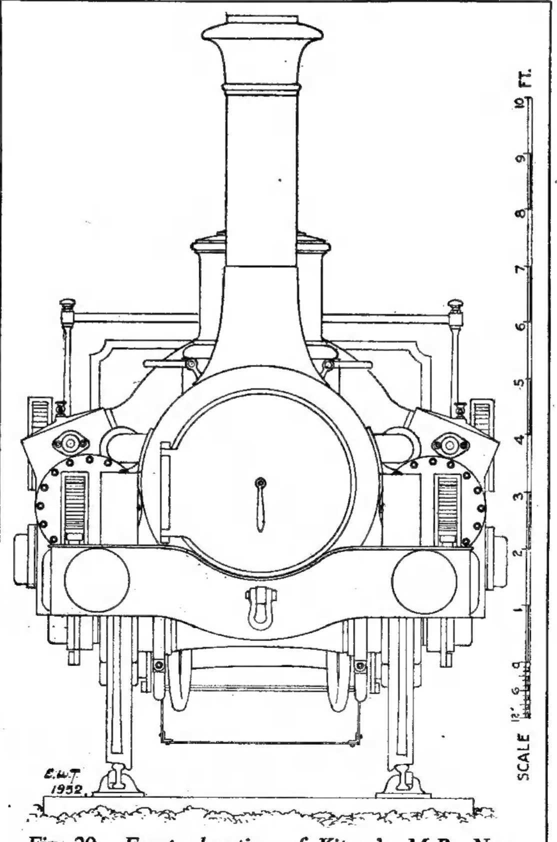


Fig. 20. Front elevation of Kitson's M.R. Nos. 130 *and* 131

shaft and levers, already schemed for Dodds's gear, close to the rear buffer beam.

The works numbers of the two engines were: 130 and 131 and it has been suggested to the writer that the wedge motion and the link motion may have been both used, one gear in each engine. This idea is negatived by the fact that in the elevation the engine bears the number "130" and the Dodds's gear drawings are definitely marked "No. 130 engine" which clearly shows that there was a change of ideas after January, 1848.

The side elevation of No. 130, reproduced in Fig. 18, is almost a facsimile of the undated original Kitson drawing and has been left unshaded in order to render it a close copy of the same. In the original there are a few little obvious errors and these have been corrected. Fig. 19 is a hypothetical reconstruction of the link motion valve-gear and Fig. 20 a front elevation of the engine; both of these last being by the writer.

Shortly after he commenced to look into this matter of the possible gear, indicated by the elevation drawing, the writer believed that the gear was Gooch's, in which the long valve-rod, together with the die-block, would be moved up and down in the expansion link by the reversing lever; but this had to be abandoned because it involved either great mechanical difficulties or putting the expansion link outside of the inner frame and there was insufficient lateral space for this. So then it was decided that the gear must have been Stephenson's, with eccentric-rods led backwards instead of forwards, and a rocking shaft almost the same as had been schemed for Dodds's gear. The detailed layout was the result. It must be understood that the writer only puts this forward as a probable solution of this little problem, which to the locomotive historian is extremely interesting and to the model engineer who would reproduce one of these two engines, a matter of importance. Older readers of this journal will know that the writer has been a model-maker during the greater portion of his life but, with all his experience; he certainly would not care to undertake to model one of these Kitson Cramptons if Dodds's gear had to be fitted and made to function correctly with the engine in steam. On the other hand, with the Stephenson gear there should be no greater difficulty than there is with the more usual arrangement of the same.

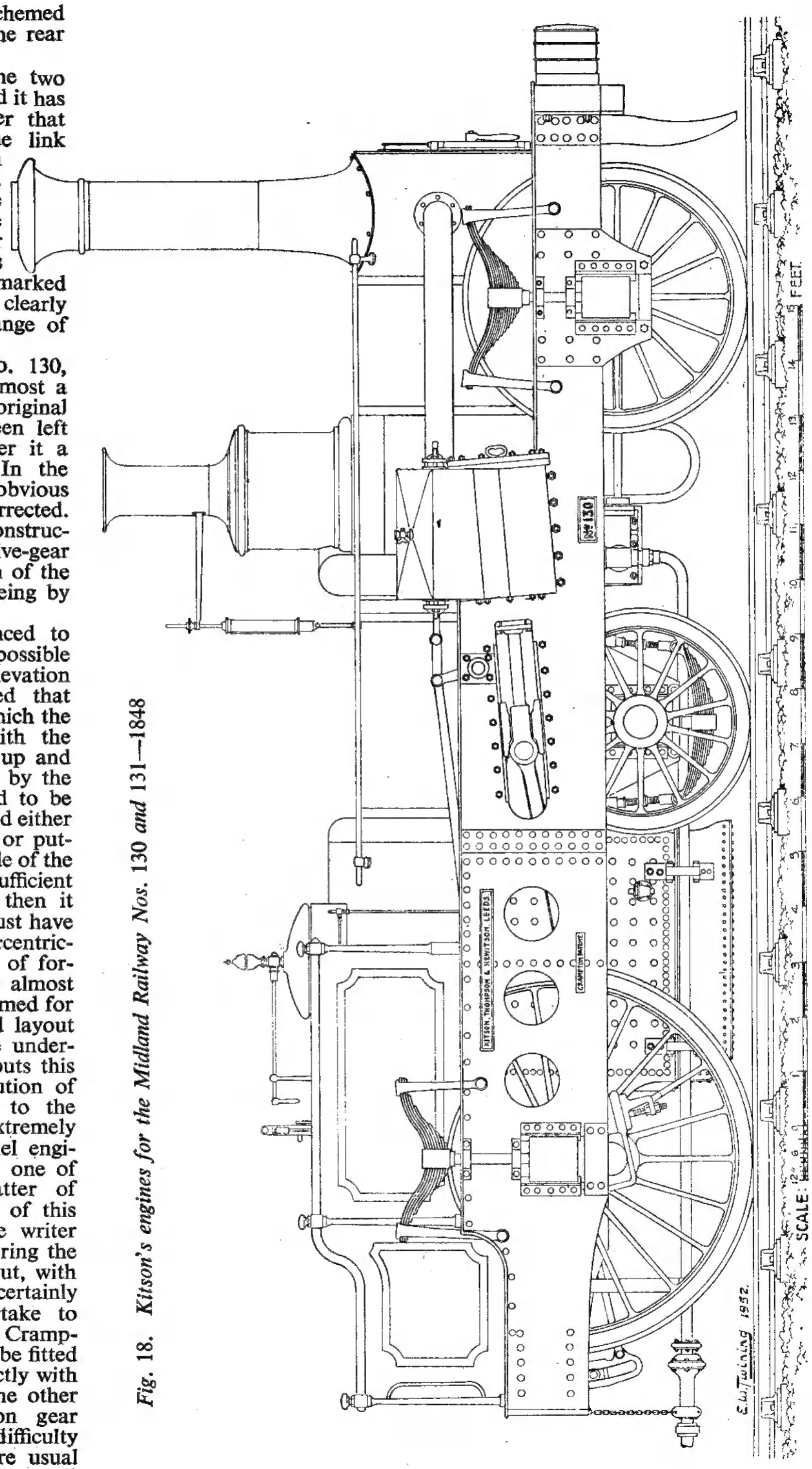


Fig. 18. Kitson's engines for the Midland Railway Nos. 130 and 131—1848

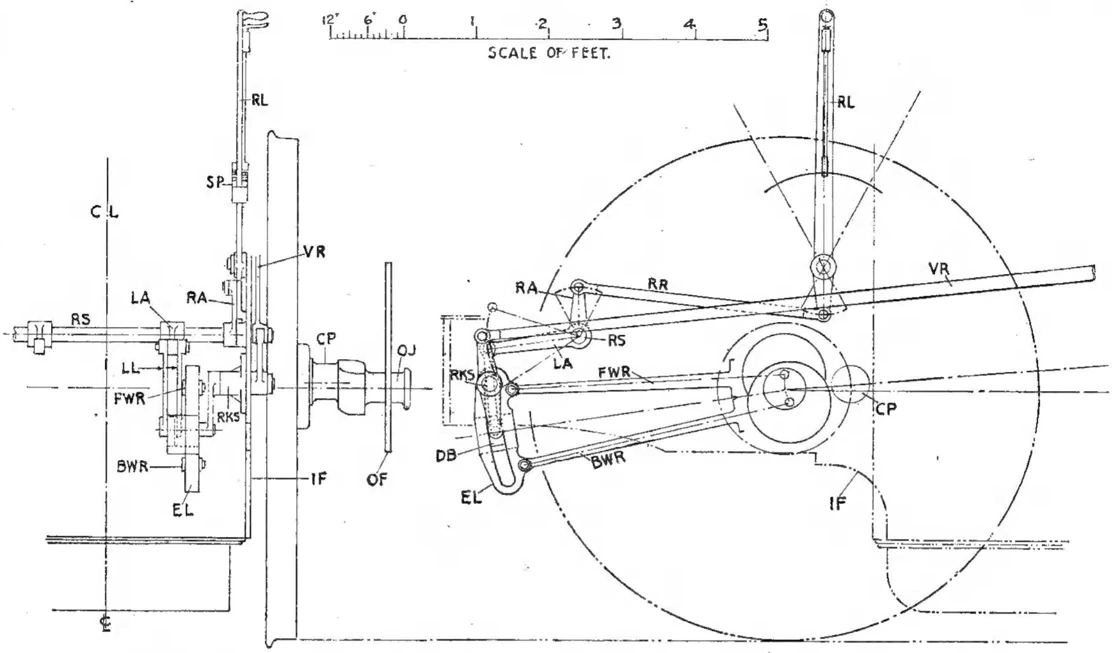


Fig. 19. *The author's hypothetical reconstruction of the valve-gear of M.R Nos.* 130 *and* 131

All the parts shown in Fig. 19 have, for convenience, been given reference letters and a list of them is as follows: CL, centre-line of engine; CP, crankpin; FWR, forward eccentric rod; BWR, Backward eccentric-rod; EL, Expansion link; DB, dieblock; RKS, rocking shaft; VR, valve-rod; LL, lifting links; RA, reversing arm; RS, reversing shaft; LA lifting arm; RR reversing rod; RL, reversing lever; SP, sector plate; IF, inside frame and firebox sideplate; OF, outside frame; OJ, outside journal. Note that the sideplates of the firebox formed portions of the inside frames. Drawings of other Kitson engines show that this peculiarity was a feature of their standard practice at this time.

The dimensions of these Midland Cramptons were as follow: Leading wheels, 4 ft. 9 in. diameter with outside bearing only. Intermediate, 4 ft. 0 in. diameter, inside bearings only. Driving wheels, 7 ft. 0 in. diameter with both inside and outside bearings. Wheelbase, leading to intermediate, 7 ft. 9 in. Intermediate to driving, 8 ft. 0 in. Total, 15 ft. 9 in. Overhang, leading end 3 ft. 4 in. Trailing end, 4 ft. 7 in. Length of frames, 23 ft. 8 in.

The outside frames, $\frac{7}{8}$ in. thick, were offset immediately behind the slidebars and were wider apart, from this point, back to the rear buffer beam to take the outer driving axle bearings. The inner frames $\frac{13}{16}$ in. thick were, as already stated, extended vertically to form part of the outer firebox shell and were carried down to the foundation ring which was made up of two angle-irons.

The cylinders were 16 in. diameter by 22 in. stroke. The centres of the cylinders were 6 ft. apart, laterally. Driving axle $6\frac{1}{2}$ in. diameter. Journals: inner, $6\frac{1}{2}$ in. diameter by $7\frac{1}{2}$ in. long. Outer: 5 in. diameter by $6\frac{1}{2}$ in. long. Crankpins $6\frac{1}{2}$ in. diameter by 5 in. long. These crank-pins were keyed directly into the hubs of the driving wheels. The boiler feed-pumps were of short stroke with rams of large diameter and were driven by eccentrics on the leading axle. In *The Locomotive*, August issue, 1922, Mr. E. A. Forward gave the following particulars of the boiler: The barrel had an outside diameter of 4 ft. $\frac{1}{4}$ in. by 10 ft. 0 in. long. formed of plates $\frac{7}{16}$ in. thick. Distance between tubeplates 10 ft. 5 in. There were 193 tubes of $1\frac{7}{8}$ in. outside diameter, giving a heating surface of 979 sq. ft. The inner firebox was 4 ft. 2 in. long by 3 ft. 4 in. wide, by 4 ft. 3 in. high and added 83 sq. ft., so making a total heating surface of 1,062 sq. ft. The grate area was 13.9 sq. ft.

With regard to the painting of these two engines nothing definite is known, but as they were delivered early in Matthew Kirtley's locomotive superintendency, on the Midland Railway, which commenced in 1844, there can be little doubt that they were painted green, picked out in black, with no fine lining. The particular green was a middle chrome, a little darker than that adopted by Mr. S. W. Johnson, Mr. Kirtley's successor. The form of the panel lining, with cut-in corners, as shown in Fig. 18, is taken from the Kitson original drawing and is in perfect accordance with the Kirtley style of picking out.

Messrs. Kitson's drawing shows the wooden lagging strips on the boiler barrel although on the firebox they are covered by cleading plate. The writer has ventured to show cleading plate on the barrel as well, for, if there was no such plating when the engines were first turned out, the lagging would not be left uncovered for long. It was at just about this time that the practice of showing the wood, either varnished or painted, fell into disuse and painted thin plate was added to cover it.

Small Electric Motors

NOTES ON THE CHARACTERISTICS OF VARIOUS TYPES

By B. Mason

THE term "small electric motors" covers a fairly wide field; each type of motor having its own particular advantages and limitations. The following summary is intended as a quick reference to enable a choice to be made of the most suitable type of motor for the job in hand. Choice of the actual machine to use should in all cases only be made after reference to the

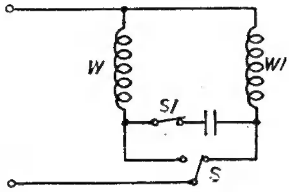


Fig. 1. *Reversal of capacitor motor*
W & W1—Starting and running windings, usually similar; S1—Automatic switch; S—single-pole two-way reversing switch

manufacturers. Special motors, e.g. high-speed motors running on high frequency a.c. supply, and a.c. three-phase types are not listed below.

The main factors governing the choice of a motor are : electricity supply; starting, accelerating, running and overload torques; speed and speed variation; reversibility; continuous or intermittent running; silence of operation and general operating conditions, i.e. whether the motor is to run in a vertical or horizontal position; in a dusty or inflammable atmosphere, etc.

If there is no choice of electricity supply, this must be the first consideration. There are four main types of small motor; d.c.; a.c. single-phase; universal (a.c.s.p. and d.c.) and a.c. three-phase.

Small motors are usually listed in torque sizes, but in a few cases the horse-power is given. The conversion from torque to h.p: is :—

$$\text{H.P.} = \frac{2\pi \times \textit{running torque} \times \textit{r.p.m.}}{33{,}000}$$

where running torque is in lb. ft.

The determination of the running torque of an existing machine is fairly easily carried out by wrapping a cord over a pulley on the driving spindle and attaching a spring balance to the end of the cord. The force needed to turn the spindle *at the correct running speed* can then be measured, and this force in pounds multiplied by the radius of the pulley in feet gives the running torque.

The measurement of the output torque of a motor is comparatively easy, and this fact can be used to determine the running torque of a machine. If a d.c. shunt or compound motor is coupled to the machine shaft and the voltage on the armature adjusted until the correct running speed is attained, the motor can then be removed and its torque measured when the armature voltage reading is the same.

If the machine is not in existence the running torque cannot, of course, be measured, and resort must be made to calculations and estimates. The motor should be chosen at as early a stage as possible to enable sufficient space to be allowed for it in the final assembly.

The starting torque is the torque necessary to start the machine from

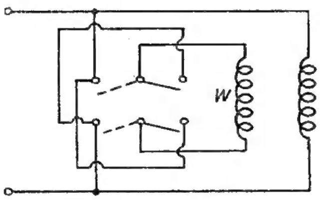


Fig. 2. *Reversal of split phase motor*
W—starting winding; W1—running winding. Reversal by means of a two-pole two-way switch

rest, and a driving motor should be chosen which has a starting torque large enough to start the machine under the worst conditions, e.g., a machine may have "dead centre" positions or may be stiffer in cold weather. In all cases the starting torque has to overcome friction, but in some instances it may have to overcome the full load, as in compressors and pumps. Fans and hand drills, etc., have virtually no load other than friction at starting.

Starting torque may be measured in the same way as running torque, but in this case the load is applied to the cord by the spring balance or by weights until the spindle starts to rotate.

The accelerating torque is the torque required to run the machine, once it has started moving, up to full running speed. In most cases it can be ignored, as a motor with sufficient starting and running torque will usually have enough accelerating torque. However, if a machine contains moving masses with high moments of inertia, e.g. flywheels; high frictional resistance or is required to reach full speed in a specified short time, attention must be paid to the accelerating torque. The torque of some motors actually falls soon after starting, and it is possible with these motors to start a machine, but not to be able to raise the speed; the motor taking a heavy current and getting hotter and hotter.

The overload torque is any torque in excess of the normal which may be imposed on the motor by the machine. Continuously-rated motors will usually exert an overload torque 25 per cent. in excess of the running torque for a period of five minutes. This does not, however, apply to continuously-rated motors used for driving fans, etc., nor to short time-rated motors.

The highest speed attainable by induction motors on normal fifty cycle a.c. supply is limited to about 2,800 r.p.m. on full load; lower speeds being about 960 r.p.m. and 1,440 r.p.m. If the speed of the machine must remain fairly constant with varying load, an induction motor of some sort must be used. Higher speeds, up to 20,000 r.p.m. can be obtained by using a series

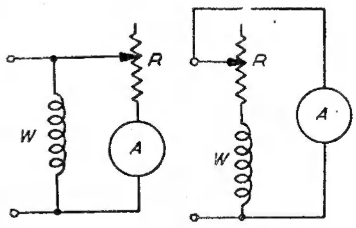


Fig. 3. *Speed control of d.c. shunt motor*
Left A—armature ; W—field winding ; R—variable resistance decreasing *speed. This method is used for permanent magnet d.c. motors*
Right R—variable resistance increasing *speed*

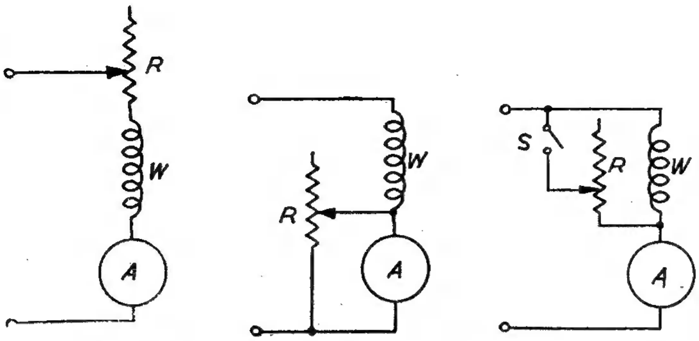


Fig. 4. Speed control of d.c. series or compound motor

(a) Decreasing speed. *(b) Decreasing speed (higher starting torque than (a)).* *(c) Increasing speed. Switch S must be open when starting*

or a universal motor, but the speed varies with the load. The lowest speed with this type of motor is about 2,000 r.p.m. D.C. motors can be obtained with speeds from 2,000 r.p.m. to 20,000 r.p.m.

The choice of variable speed motors is very limited; all induction motors being unsuitable. By wiring a variable resistance or choke in series with a series motor the speed can be decreased. It should be realised that the power developed by a motor drops off rapidly with a decrease in rotor speed, and that any method of speed control that reduces the speed of the motor should be used with caution. Also, although a motor with a resistance in series may drive the machine at a slow speed, it may not start it from rest and it would then be necessary to start at full current and reduce when the machine was running.

Variable resistances can also be used to control the speed of d.c. motors and, in this case, an increase of speed can be obtained.

Shaded-pole and capacitor-run motors can be used with variable resistances in series, but the speed control is limited with these types.

Rocking brushes can be employed to vary the speed of, stop and reverse a.c. repulsion motors.

Speed control of other types of single-phase motors can only be obtained if the motor is specially wound. External switching is used to vary the number of poles, and the choice of speeds is limited to 960, 1,440 and 2,800 r.p.m. It should be noted that if any motor fitted with a centrifugal switch does not attain full speed, the switch may remain closed with the result that the starting winding will be burned out.

All small motors can be reversed by one means or another; perhaps the simplest method being the double-pole double-throw switch. The following motors, however, cannot be reversed by this method : Attraction, repulsion and repulsion start induction, one-winding compensated universal, shaded pole and synchronous. The one-winding compensated universal and the repulsion motor can be reversed by rocking brushes. The remaining types: Repulsion start induction, synchronous, attraction and shaded pole require special motors wound for reversing service.

Where a motor is to run continuously, care should be taken to choose one which is so rated, otherwise overheating will occur. In the case of a motor required for intermittent use, it is often worth while to incorporate an overload device in the circuit to guard against the machine being left running.

Silent running is very often a necessary feature and this must affect the choice of motor. In general, all motors make some noise, be it mechanical or electrical, and should be mounted on rubbers where possible. Commutator motors tend to be very noisy at the brushes, and induction motors are to be preferred. Gearboxes are always a source of noise and any out of balance factor on the motor armature is accentuated by high speeds. Choice of the slowest running motor which will fulfil the necessary requirement minimises both these effects. Ball-bearings are more noisy than plain-bearings, but are to be preferred when the motor is not running horizontally.

Where a motor is not to be mounted horizontally, or if horizontally, in an inverted position, care should be taken to see that it can be lubricated properly. It may be necessary to connect suitably bent tubes to the lubricating nipples.

If the motor is to be run in a very dirty, dusty or moist atmosphere, it should be protected and even totally enclosed. It should be remembered, however, that adequate ventilation is essential to the satisfactory working of a motor. If the motor is enclosed it will have to be larger than if it were not, in order to prevent overheating. Some measure of protection must always be given and, as a rule, it should be impossible to insert one's finger into the "works." If the atmosphere in which the motor is to run is inflammable or explosive, flameproof motor and switchgear should be specified.

Finally, as mentioned above, it

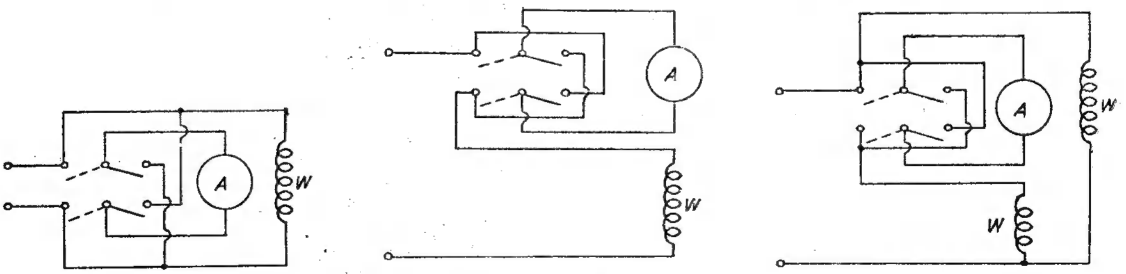


Fig. 5. Reversal of d.c. motors

(a) Shunt motor *(b) Series motor* *(c) Compound motor*

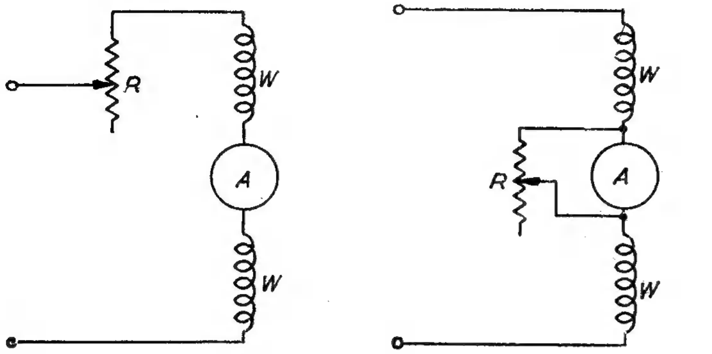


Fig. 6. Speed control of universal motor

(*a*) *Resistance in series with winding*

(*b*) *Resistance in parallel with armature (higher starting torque than (a)*

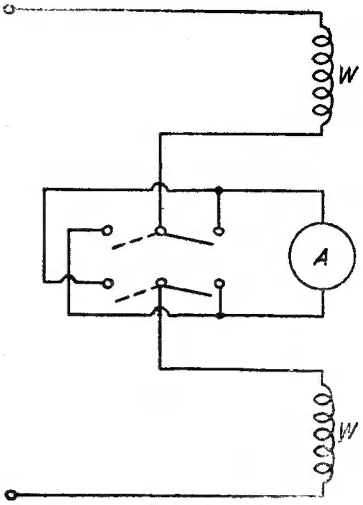


Fig. 7. Reversal of universal motor

is not always possible to reverse a motor by simple means and, therefore, the direction of rotation required should always be stated unambiguously on a motor order.

Descriptions of the various types of small motors are set out below.

Synchronous Motors

The speed of a synchronous motor depends entirely upon the frequency of the a.c. supply; changes in load and voltage producing no change other than overheating when they rise too high. The relationship between speed and frequency is :

$$S = \frac{120 \times F}{N}$$ where S = r.p.m.

F = frequency in cycles per sec.

N = number of stator poles.

The simple synchronous motor is not self starting, but can be made so by a modification of the design. A modified motor of this type will run at less than its synchronous speed if the load rises too high, and care must be taken that this condition does not arise. A synchronous motor tends to be much larger, power for power, than an ordinary induction motor and produces more vibration. This is minimised, however, in the case of a single-phase motor by the use of the capacitor-run type.

Capacitor Start Motors

The capacitor start motor is built with a capacitor in series with one winding and is for use on a.c. single-phase supply. The motor is fitted with a centrifugal switch which cuts out the capacitor at full speed. It has a high starting torque, is silent running and does not produce radio interference. It can be reversed by means of a single-pole two-way switch.

Capacitor-run Motor

This motor is similar to the capacitor start motor but the centrifugal switch is omitted, with the result that the capacitor is in circuit all the time. It is very silent, has better running characteristics than the switched type but has a low starting torque. Its speed can be varied by connecting a variable resistance or choke in series with the windings.

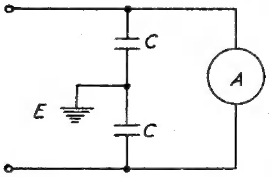
Capacitor Start and Run Motors

This type is merely a combination of the previous two; the motor being fitted with two capacitors. One capacitor is cut out at full speed by the centrifugal switch while the other remains permanently in circuit. Although expensive, it is, perhaps, the best type of single-phase motor.

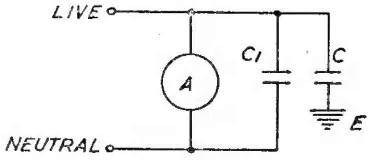
Repulsion Motors

The repulsion motor has a high starting torque but its speed varies

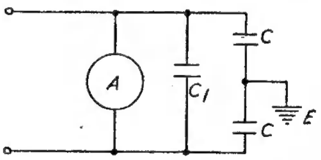
(*Continued on page* 746)



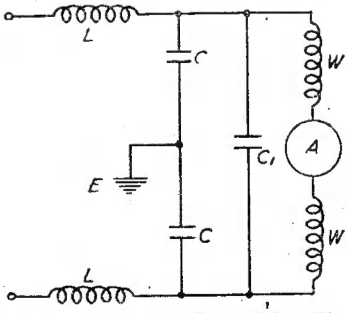
(*a*) *Two condensers, C, connected to earth. E (usually the motor frame). Condensers* 0.005 μF *for* 230 *volts or* 0.01 μF *for* 110 *volts*



(*b*) *Two condensers, C1—0.05* μF. *C as in (a)*

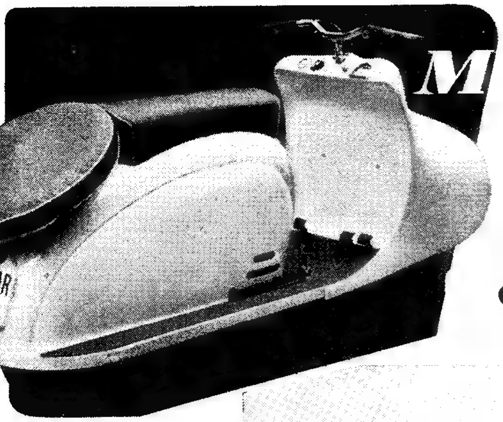


(*c*) *Three condensers, C1—0.05* μF. *C as in (a)*



(*d*) *Three condensers and two chokes, C1—0.05* μF; *C—as in (a); L—3,000* μH.

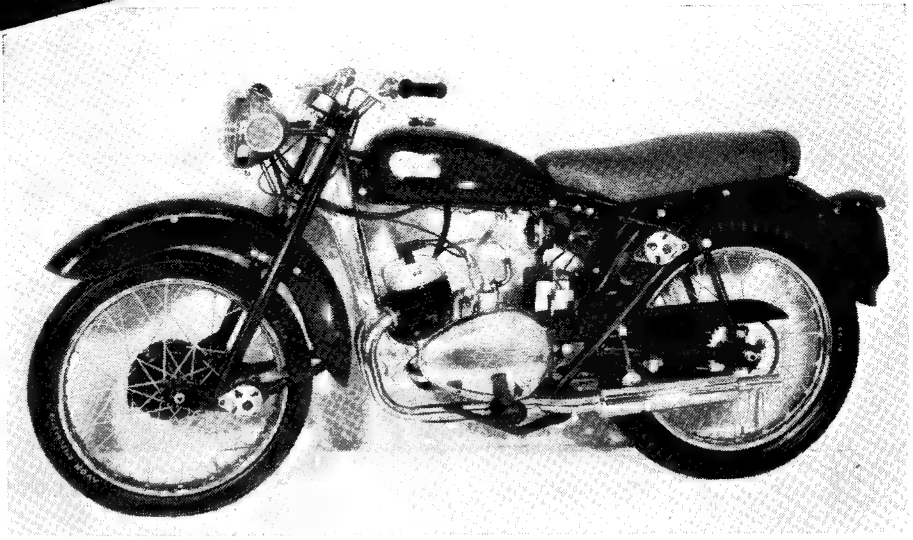
Fig. 8. Interference suppression



Motor-cycle Makers Look Ahead

BOLD ENGINEERING DESIGN CHARACTERISES MANY NEW MODELS

Above: The 197 c.c. Oscar is an unconventional machine with a tubular "chassis" and glass-fibre body



Right: The new Anzani engine is fitted to the 250 c.c. Model 25D "Fleetwing," made by Greeves. Note the unusual front frame-member

THOSE model engineering enthusiasts who visited the recent Motor Cycle Show will not need to be told that it was highly stimulating and of great technical interest. Those who were unable to attend, or who may have felt that it was outside their sphere of interest, may derive some benefit from the following résumé by a staff reporter. They will at once appreciate that this industry offers some very attractive studies in design, as well as inspirations for small-scale engineering. It is likely that in most cases, manufacturers would be only too willing to provide interested persons with literature, photos and possibly even drawings.

The greatest interest undoubtedly centred around motorised cycles and lightweight motorcycles and their propulsion units, but many expensive, high-performance machines and a few three-wheelers provided food for thought, as well as possible action.

There are, today, over 200,000 auxiliary cycle motors in use. These appear to vary in price from 16 gns. to £40. Seven manufacturers showed an impressive range of units of this type. Two were seen for the first time and are representative of the two main types in use. One, the B.S.A. Winged Wheel, is a self-contained unit mounted inside a large drum in the rear wheel. The other, the Vincent Firefly, is a friction-drive unit fitting low down in the cycle frame.

Another modern unit which was on view, was the Power-Pak, and here, the makers had really gone to town and had on the stand a mechanic, with a battery of Mercer gauges near at hand, busily assembling engines, it being claimed that all these Power-Pak units are hand-built. This unit has a feature somewhat grandly called the Synchromatic Drive—actually a small sturdy clutch, the operation of which is linked with that of the throttle.

These cycle motors are beautiful little jobs, and in effect, might almost be said to represent model engineering on the commercial scale. Piston diameter is little more than that of a half-crown piece in many cases, and in one example, the con-rod is little thicker than a pencil at its upper end. The 32 c.c. Cyclemaster has a lovely little exhaust system with a pipe about $\frac{5}{8}$ in. diameter. The Vincent Firefly has an inlet pipe that could hardly be more than $\frac{3}{8}$-in. bore, and a tiny, delightful carburettor with a float not much bigger than a thimble.

Between the cycle motors and the true lightweight motorcycles there is a class comprising the fairly recently devised—some will say *re*-vised—motor scooters. That which drew the greatest measure of attention at the show was, without a doubt, the Oscar. This machine is notable for rubber suspension fore-and-aft, a duplex $1\frac{3}{8}$-in. 16-gauge steel-tube frame, and channel-section horizontal forks. The suspension in each case actually comprises a bonded-rubber bush in a steel tube, and it is the torsion resistance of the rubber that provides the suspension. Other features are quickly detachable and interchangeable wheels, and glass-fibre bodywork which encloses all the working components. Engine and gearbox are of Villiers make.

Another interesting scooter of

today is the Lambretta. Its most notable feature is that engine, transmission and rear wheel form a complete swinging-arm unit mounted on a central pivot, and suspended by means of a torsion bar. Front suspension is by two rocker arms and progressive helical springs in a grease-tight unit.

In the lightweight motorcycle field the greatest point of interest in the 1954 models lies in the wide use of pivoted-fork suspension, for front as well as rear wheels. These take various forms, but generally incorporate hydraulic telescopic suspension units.

An entirely new machine in this class is the Greeves. Once again, there is front and rear suspension, and in this case, rubber in torsion is used as the suspension medium. The conventional tubular frame has been replaced by one consisting largely of cast-alloy members.

The pivoted-fork rear suspension is normal, except for the use of rubber-in-torsion, but the front-fork assembly is of the leading-link type and unsprung weight is at the minimum.

Dot Cycle and Motor Manufacturing Co. Ltd. showed specialist machines—i.e. for trials, etc.—and all had pivoting-fork suspension and an interesting form of silencing equipment, consisting of a small expansion chamber near the exhaust port and a larger, lozenge-shaped silencer in the normal position at the rear. Tandon Motors Ltd. also exhibited machines with pivoting-fork suspension, and one of these had the new Anzani 246 c.c. twin two-stroke engine, an ingenious unit with rotary ports in the crankcase. This unit is also used in one of the Greeves machines. It is a side-by-side vertical twin with separate crankcases and alternate firing order. The crankcase halves are divided horizontally, the lower casting comprising two chambers separated by a central induction chest, and space for a wide central bearing. This bearing and the flywheel webs are both ported.

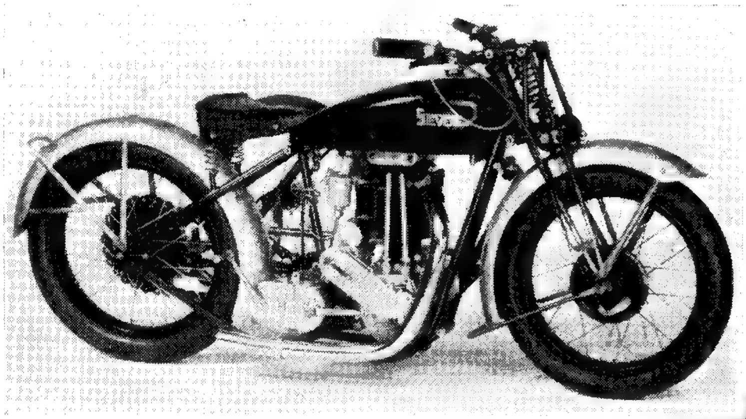
Another interesting power unit fitted to a number of 1954 lightweights, is the new Villiers 225 c.c. Mark 1 H. This is a two-stroke engine-gearbox unit with what must be the cleanest external design ever seen in a unit of this type. Carburettor, flywheel magneto and ignition coil are all enclosed and the complete unit is almost perfectly symmetrical and of " aerodynamic " shape.

There were certain other interesting exhibits at the show, of a somewhat more general interest. On the B.S.A. stand, there was an example of the company's research methods, in the form of a model of a crankshaft made in plastic and used to indicate stress distribution. When the model is viewed in polarised light and a load is applied, stress distribution is made visible in the form of a pattern of coloured fringes. The one in question illustrated good and bad fillet design.

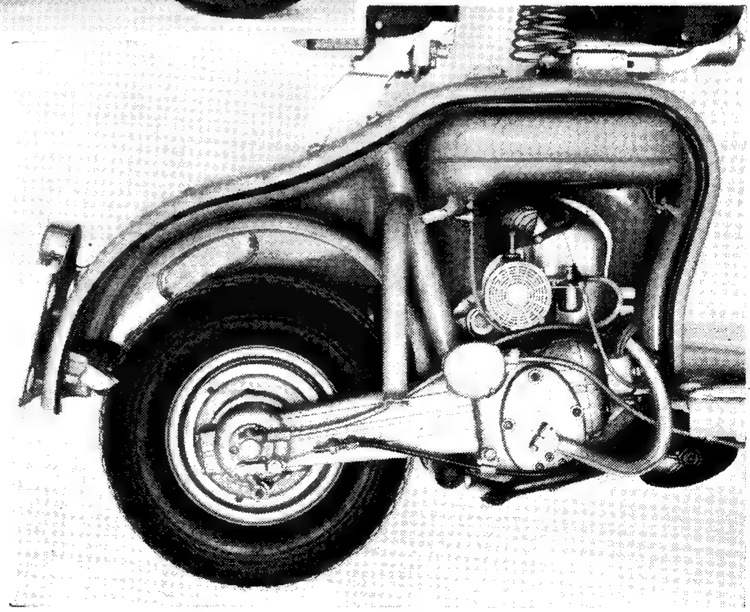
Amals showed a complete carburettor body built in Perspex and used for observing flow characteristics when used on a racing engine. Many model engineers, incidentally, must have been fascinated by the tiny Amal Type 335/3 carburettor. At the other extreme, an " inflated model " was seen in the form of a Sturmey hub gear, the diameter of which approximated to that of a complete cycle wheel !

A number of the three-wheelers were of more than passing interest. The Reliant, for example, was notable for its single front wheel with torsion-bar suspension, and the A.C. Petite for its 350 c.c. Villiers engine and independent suspension all round.

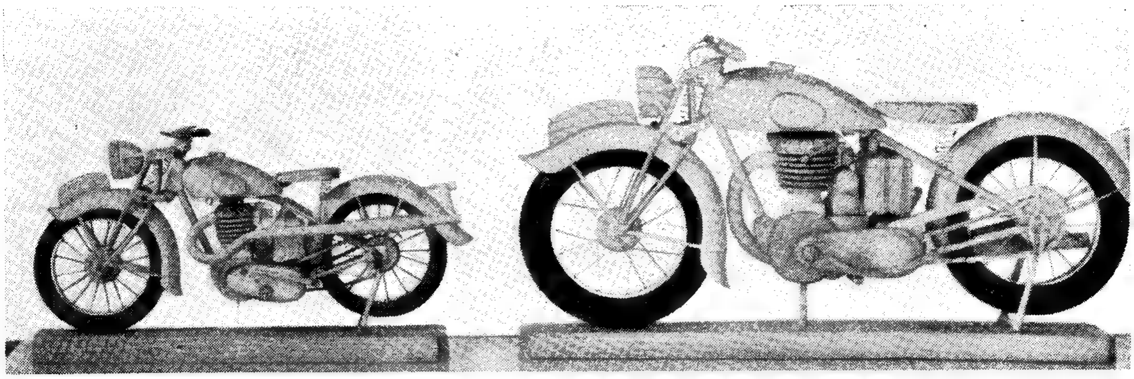
Finally, a great attraction was offered by the Auto-Cycle Union's exhibit, comprising a collection of models of motorcycles, ranging



Left: In September, 1949, we published this photograph of Mr. Wills's Stevens motor-cycle, which was prominently displayed at the 1953 Motorcycle Show, complete with sidecar



Right: Interesting power and transmission assembly of the Lambretta



These wooden models were exhibited at the 1949 Model Engineer Exhibition

from comparatively crude non-working types up to the beautiful 7.25 c.c. Stevens sidecar outfit of 3 in. to 1 ft. scale, made by Mr. G. F. Wills of Leyton. These included numerous silver models which have served as race trophies and most of which are the property of oil companies. These are really handsome examples of craftsmanship—perfect even to such details as the nipples on control levers—but are not working models.

The Auto-Cycle Union has instituted an open competition for the building of model motorcycles, details of which are given elsewhere in this issue.

SMALL ELECTRIC MOTORS

(*Continued from page* 743)

with the load; maximum speed being considerably higher than synchronous speed. It is for use on a.c. single-phase supply. Reversal and speed control can be effected by rocking the brushes which, incidentally, do not cause radio interference.

Repulsion Start Induction Motor

The high starting torque characteristic of the repulsion motor is made use of in this type. A centrifugal switch comes into action at full speed, converting the motor into a normal induction motor and thus eliminating the undesirable variation of speed with load. In some designs the centrifugal mechanism lifts the brushes off the commutator. Reversal can be effected as for the repulsion motor, but the speed is fixed.

Shaded-pole Motor

The shaded-pole motor is a relatively trouble free type, but it has a very low starting torque and is inefficient. It is used in innumerable cases where a low driving power is required. It cannot normally be reversed but specially constructed motors can be obtained when this is necessary. The speed varies with load and is, in any case, always less than the synchronous speed. Speed can be varied by connecting a variable resistance or choke in series with the windings. The motor is silent running and does not cause radio interference. It is for use on a.c. single-phase supply.

Split-phase Motor

Like the shaded-pole motor, the split-phase motor is for use on a.c. single-phase supply, it does not cause radio interference and is silent running. Unlike the shaded-pole its speed is fairly constant and, on 50 cycle mains, is limited to 960, 1,400 and 2,800 r.p.m. full load. The starting torque, although not high, is about twice the running torque and thus this motor finds numerous applications. Reversal can be obtained by means of a double-pole, double-throw switch.

D.C. Motor

The shunt wound d.c. motor possesses a moderately high starting torque and a fairly constant running speed.

The series wound d.c. motor has a very high starting torque but the speed varies greatly with the load.

High starting torque combined with constant speed is attained in the compound wound d.c. motor. Permanent magnet d.c. motors have a fairly constant running speed and a moderate starting torque.

D.C. motors, other than small ones, should never be switched direct on to the mains. They all tend to be noisy, cause radio interference, and are capable of easy speed control. The speed can be either increased or decreased by correct wiring of resistances in the field or armature circuits. Reversal can be effected by simple switching.

Universal Motors

The universal motor can be used on either d.c. or a.c. single-phase supplies (provided the voltages are the same). The full load speed tends to be high and running speeds vary with load. The motor is noisy and causes radio interference. Speed control is simply effected by connecting a variable resistance in series with the motor. Reversal is carried out by means of a two-pole double-throw switch, but sparking and excessive wear of the brushes may take place in the reversed direction. Reversing requirements should, therefore, be stated before purchasing the motor.

Various modifications of all the above types of motors are available but are far too numerous to list here. Once again it is emphasised than an enquiry to a motor manufacturer is always the best approach to a motor problem. The remarks made under the individual motor headings are of necessity brief, and reference should be made to the introductory paragraphs regarding general considerations of reversal, speed control, etc.

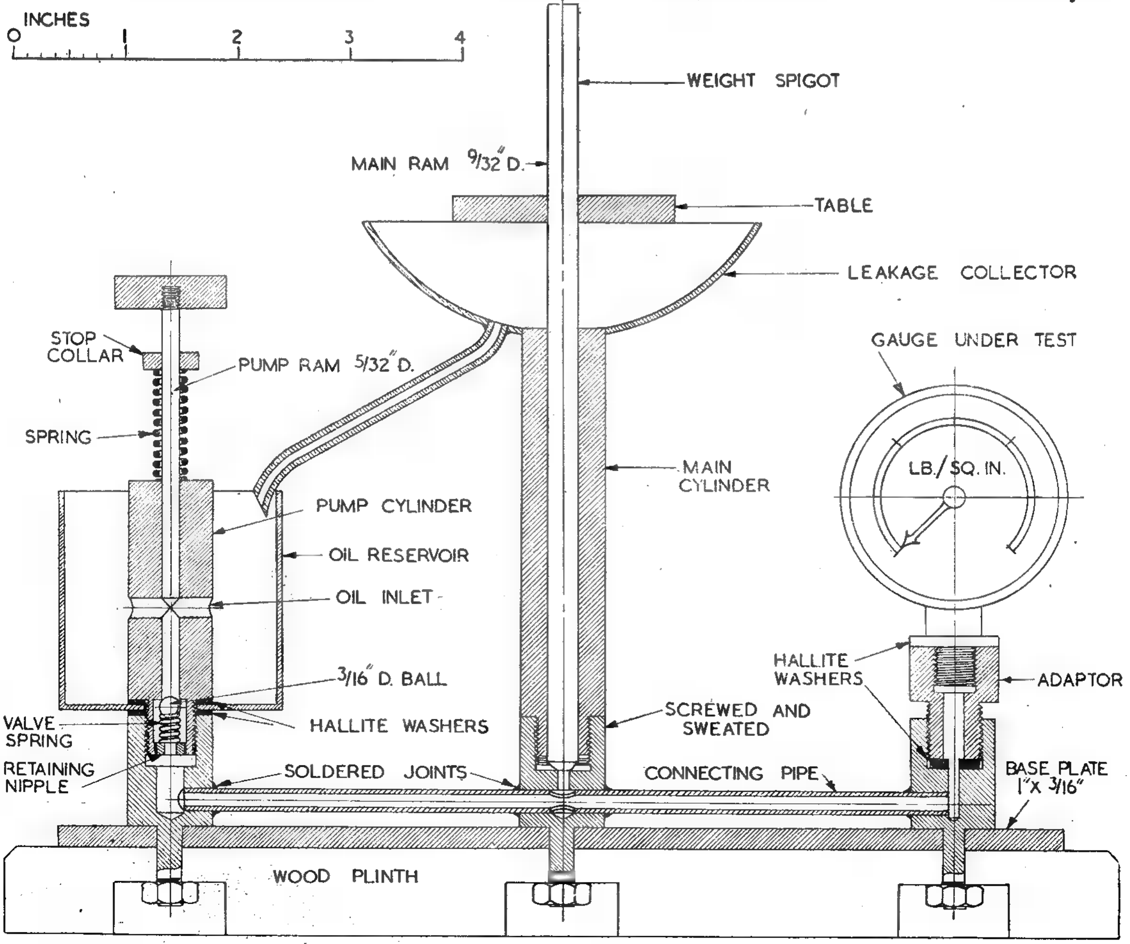
A Pressure Gauge Calibrator

By M. E. Moon

HOW many users of pressure gauges ever give a thought to the accuracy of their instruments? Many gauges are born liars, some lose their morals through being dropped, or by being subjected to pressures above their range, whilst old age makes most of us, even pressure gauges, a bit slow off the mark. It is the purpose of this article to describe a simple calibrator, or tester, which may be used to check the readings of a gauge, or to make a new dial if such is needed. With its aid it is a simple matter to make one's own gauges by fitting the works of a car oil-gauge (which may often be obtained from a garage or breaker's yard for a very nominal sum) into a brass case suitable to the user's requirements. As a matter of fact, several of the writer's most useful gauges came from this source.

The principle involved is that of applying a known weight to a ram, or piston, of known area, in order to apply known pressure to a fluid which operates the gauge. Now a rod of 9/32 in. diameter has a cross sectional area of $\frac{1}{16}$ sq. in. within less than 1 per cent. error, which is sufficiently accurate for all practical purposes. (In any case, the fault is on the safe side, an applied pressure of 621 lb. will read as 625 lb. on the gauge.) Therefore, a weight of 1 oz. applied to the rod will equal a pressure of 1 lb. per sq. in. If this rod, suitably weighted, is fitted into a cylinder in communication with the gauge to be tested, and oil is forced in by means of a pump until the ram begins to rise, we have a means of obtaining the necessary measured pressure required to test or calibrate a gauge. The important point is to have the ram perfectly free within the cylinder, and, at the same time, oil-tight. The method to be described enables such a fit to be obtained. The average model engineer will probably be able to find most of the materials needed in his scrap box, and with the exception of the ram, none of the measurements given need be strictly adhered to.

The sectioned drawing accompanying this description should be almost self explanatory. The base may be of brass or mild-steel, and the rest of brass. The joints



shown should be tinned before assembly, and then carefully soft-soldered together; it is amazing how oil under 300 lb. pressure can find its way through the merest vestige of a crack or pinhole. The parts requiring the most care are the ram and cylinder.

First, obtain two lengths of 9/32 in. ground silver-steel, trim off half-an-inch or so from all four ends, and remove the sharp corner. The idea of this trimming is because the ends are often distorted when cut to length by the makers. Chuck one piece in the lathe, and, with fine emery cloth, reduce the diameter for a length rather more than that of the cylinder by about half-a-thou. or so. File the end to a slant, harden and temper to a light straw, and stone up, in the manner so often described in these columns by "L.B.S.C."

Now chuck a length of ¾ in. brass rod, centre and drill right through with your longest 17/64 in. drill. Obviously, the length of the rod will depend on the drill, and should be as long as possible. Chuck the reamer in the tailstock chuck, and with the tailstock free to slide upon the bed, push it right through the hole in one operation. Clean out the hole, and then put the other rod in the tailstock chuck. Using plenty of oil, push the rod slowly right through the bore. Work it back and forth, keeping the end of the rod always protruding through the bore, clean both rod and bore frequently, and continue until the rod is a smooth sliding fit in the hole. It will probably be found that the rod is a better fit on one part of its length than another, so mark this section, and use it for the ram. Now turn down the end of the cylinder for about ⅜ in., and thread any convenient thread about half-an-inch in diameter, I used ¼ in. gas. This thread should be a free fit in the base pillar to avoid closing up the bore when screwed home. Remove from the chuck, tin the thread, and fit a bowl to the upper end; anything handy will do, I used the gong from an old electric bell fitted with a short piece of copper tube for a drain pipe.

Next, solder a brass blank, about 2 in. in diameter and ¼ in. thick, on to the ram so that it is level with the top of the bowl when the ram is just below the end of the cylinder. Chuck the assembly, face the top, bottom and edge of the blank until the assembly weighs exactly 5 oz. Obviously, the weight of the ram must be taken into account when using the apparatus, and 5 oz., equal to 5 lb. pressure, is a convenient figure to use.

The pump is made in a similar manner, using 5/32 in. silver-steel, but the end is bored out to 17/64 in. diameter, and a seating formed with a D-bit. The hole is tapped 5/16 in. by 40 thread, and a 3/16 in. steel ball, held in place with a light spring and nipple, fitted. Three-quarters of-an-inch above the shoulder a 5/32 in. hole is drilled right through from side to side to form the oil inlet. A collar is secured to the pump ram, with a spring under it to return the ram on the up stroke. This spring must be of such a length that it lifts the ram above the inlet hole when extended, but when fully compressed prevents the ram touching the ball-valve.

The oil reservoir is made from any handy piece of brass tube, with a blank soldered in, and drilled to fit over the thread. A knob should be fitted to the top of the ram for comfort in operation. If circular stuff is used for the pump cylinder, two flats should be filed at the top to enable a spanner to be used to tighten it up.

The end pillars to carry the gauge and pump, and the centre one for the main cylinder need no detailing. They may be round, hex. or square, as is convenient. They have screwed spigots turned on the bottom to secure them to the base, and are joined with copper or brass tube soldered in place. The whole is fitted to a wood plinth to provide a secure base when in use.

Adaptors may be turned from hex. material, screwed externally to suit the end unit, and tapped internally to suit the gauge to be tested. The sealing washers may be of Hallite, or red fibre, and must not be omitted.

The smaller weights can be turned from odd ends of steel bar, or anything else handy, and the larger ones may be cast in lead. Pour the molten metal into tin cans which have previously been made red-hot to remove the tinning, and, when cold, remove the can. The weight can then be turned. All weights must have a hole in the centre 5/16 in. in size to fit the spigot above the table. They should be wide and thin, as several may have to be used at once, to make up the requisite pressure.

These will enable readings to be taken from 5 lb. per sq. in. up to 300 lb. per sq. in. by [illegible] lb. increments. If a maximum of 160 lb. is all that is needed, omit the last weight; alternatively, the range may be increased to suit the user's requirements up to the point where the whole issue collapses.

Weights will be required as follows:

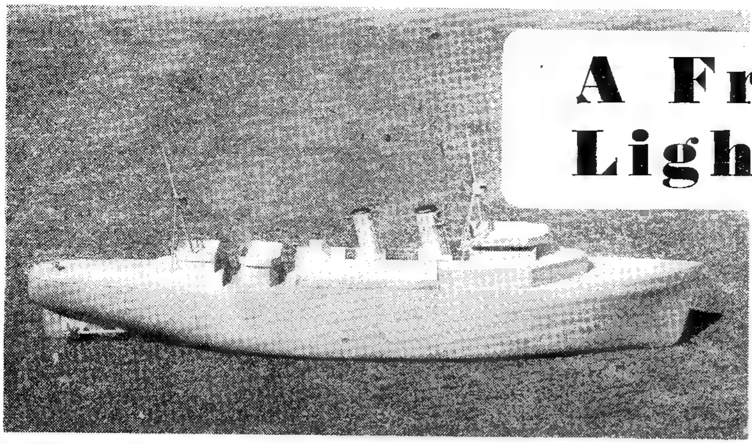
Actual weight	Marked as
1 oz.	1 lb.
2 oz.	2 lb.
4 oz.	4 lb.
5 oz.	5 lb.
10 oz.	10 lb.
1 lb. 4 oz.	20 lb.
2 lb. 8 oz.	40 lb.
5 lb. 0 oz.	80 lb.
10 lb. 0 oz.	160 lb.

To use the calibrator; first fill the reservoir with thin lubricating oil, and pump until oil appears at the gauge pillar. Screw in the gauge, and place what weights you require on the table, not forgetting to allow for the weight of the ram (5 lb.). Pump until the ram rises about an inch or so. It should now be possible to spin the ram and weights quite freely, and they should continue to spin for some time, and it is while they are spinning that the readings are taken. Test the gauge both up and down the scale, as frequently different readings will be obtained in each direction, particularly if the gauge mechanism is sticky. In the latter case, additions of small weights to the table will not register on the dial. The remedy is obvious, clean the mechanism.

The foregoing will, I hope, enable the device to be constructed, and I trust that when you use it your favourite gauge will not surprise you as much as mine did.

GRAPHITE LUBRICANTS

In a recent article in THE MODEL ENGINEER, attention was called to the properties of colloidal graphite for dealing with special lubricating problems. This substance is usually employed in conjunction with oil or grease, but we are advised that in cases where ordinary lubricants are inconvenient or objectionable, it can be obtained dispersed in a volatile liquid, which dries out, leaving a hard, resistant graphite film of high lubricating quality. We have tested a sample of this preparation, known as Microloid Dry Lubricant, which has been submitted to us by British Industrial Products, Selwyn House, 3, Lansdowne Terrace, London W.C.1, and find it highly successful on the sliding parts of machines and instruments, trigger mechanisms, escapements, etc. It can also be used in the assembly of working parts of engines where clearance limits are very small, such as the pistons of small i.c. engines, in which it reduces initial friction and risk of seizure during the running in period.



A Free-lance Light Cruiser

By

Victor B. Harrison

IN THE MODEL ENGINEER of July 3rd and 10th, 1952, an article was published about my compound-engined marine plant driven by a coal-fired flash boiler of the same type as Mr. Rogers' *Sentinel* locomotive. Mr. J. N. Maskelyne asked me to let him have an article on the performance of the plant when it was installed in the completed light cruiser. This I promised to do.

It has since dawned upon me that this cruiser would take me about a year or eighteen months to complete, and by that time readers would have forgotten all about this novel plant. Knowing that Mr. Maskelyne was very interested in the experiment, I wrote to him and told him that the plant was most successful on its trials in the hull, but it would be a long time before I could write the requested article, because of the time it would take to complete the cruiser. In his reply he asked me to let him have the story of the trials up-to-date now, with some photographs. So, without any further preliminaries I will give the tale of my adventures.

The Hull

This was constructed for me by Messrs. Bassett-Lowke and it is 5 ft. 3 in. long with a beam of 8½ in. and a depth of 6¾ in. from the main deck to the keel. It was designed round the plant and Messrs. Bassett-Lowke have made an excellent job of it. I would have done it myself, but I felt that it might be a job beyond me, as I no longer have the energy at my age for a big job like that; nor could I get hold of the necessary seasoned wood for the purpose.

I collected the hull from Northampton, with the plant installed, in the late autumn of last year, and naturally was most anxious to try matters out on my pond; but the weather last autumn and winter, as we all know only too well, was not at all suitable to sit by a pond side, so I decided to start building the top-hamper.

Then appeared the first snag, the plant was installed slightly askew in the hull and I think that was quite accidental. I presume it happened in getting it lined up with the propeller shafts. A 1/64th in. out at that end can quite possibly put it out a ½ in. at the boiler end. I hated to have to do it, but it was the only solution that I could think of, and that was to move the boiler with the attached smoke manifold ¼ in. out of centre. I am glad to say that it was successfully accomplished, and I was able to get on with the top-hamper and the first structure was to hide the smoke manifold.

I will explain that two parts of the deck are removable one over the plant itself, so that it can be easily removed, and the bridge deck can also be lifted off for firing purposes. To remove the plant, which just rests on four pegs and is not fastened down, it is only necessary to disconnect the under-water pipe to the circulating pumps, the discharge pipe from the condenser, the condensate discharge of the wet and dry pump, the bilge pump discharge, and the drain cock discharge from the steam drum. The worst one was the underwater intake. It was most difficult to connect the pipe to the pump union. The first time, all went well; but after disconnecting it a second time, I spent a whole morning trying to reconnect it. It was very difficult to get the union nut to thread on to the fitting on the pipe. Like Hitler, my patience became exhausted and I devised the following method to simplify the operation.

The underwater fitting in the hull had a wire gauze fitted over it which, on trials, I found was a wise precaution as it definitely stopped muck getting into the circulating water pumps. I made a new fitting in which the gauze was removable. Into the end of the tube I cut a slot to fit a screw-driver. I was then able to hold the union nut in position with a pair of long-nosed pliers, push the tube from the outside of the hull to engage the union and then with a screw driver screw it home and with a special spanner pull it up tight. The gauze was then screwed back into place. This plan has worked excellently ever since, as I have had cause to remove the plant on more than one occasion.

Auxiliary Boiler

While testing the plant before it was installed in the hull I used a boiler I have by me to create the forced draught required for getting the coal fire going in the boiler. This has to be kept going for about ten minutes so as to get a real good solid and fierce fire. It dawned on me that this method would be a bit of a problem at either my pond side or any other pond side, so I had made for me by Mr. Layton of Messrs. Bonds, a small vertical boiler measuring 5¾ in. by 3 in. with a centre flue containing four cross water tubes, and fired by a small three-wick spirit lamp. This boiler is installed just ahead of the main boiler and is well below the deck-line and has become now a permanent fixture in the ship. It does its job perfectly and from the time of lighting the spirit lamp to the fire being O.K. in the main boiler takes about a quarter of-an-hour. The little boiler runs for about twenty minutes and so enables one to test everything out before commencing a voyage.

At last, the great day arrived, and the cruiser was taken to the pond side; with a liqueur glass of brandy she was christened *Pandora* by my wife, and launched. As I feared, in spite of the weight of the plant she floated high out of the water with a list to starboard which was quite easy to correct to one to port by giving her a push over the other way. Fortunately, I have plenty of lead blocks by means of which I got her down to about ½ in. of her final water line and I am glad to say she became very stable indeed.

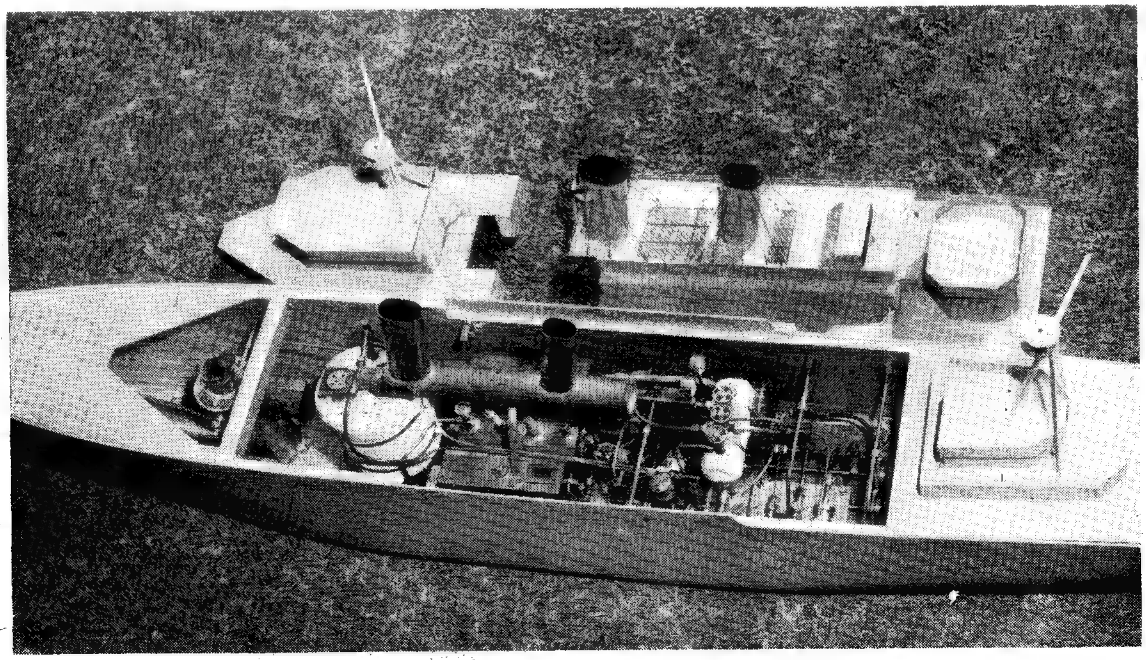
Steam was raised, the circulating pump engine was started up and in a few seconds the discharge was pouring out of the side in a most realistic manner. When I was satisfied that the fire was going well, I started up the main engine. Away it went as if it had got no load at all. I then let the ship go with the rudder suitably set for a round trip. She completed about two thirds of the circle and then came to a stop. When she eventually came alongside I turned off steam, and when I tried to turn the engine by hand it was absolutely fixed; *Pandora* seemed to be living up to her name. I brought her indoors and found that the apparent seizure must be in the main engine. I had to remove the boiler, the pressure tank and the water tanks to get at the engine, and finally I removed the engine itself.

On removing the crank-pins, I found that the seizure was on the low-pressure crank-shaft. The bearings are solid ones and when I unscrewed the bearing next to the crank-disc the shaft revolved quite easily, but when I screwed it down again to the base it seized again. The question now was: why did it work quite all right on the various tests outside the hull, and then suddenly start seizing in the hull? I found there definitely was a bit of play in the hold-down screws, and finally I got the bearing back into position when the shaft revolved quite easily; I then made sure that it would not shift by screwing it down well and hard. I came to the conclusion that this bearing had shifted because in the ship it had run for the first time under load.

Having reassembled the plant I had another bench test and found that all was well. Then came trial number two on the pond. Steam was raised and the ship completed two circuits with the decks off and at a grand speed. My wife held the boat while I stoked up, and when the fire had burnt up with plenty of flames, I put on the decks and let her go. She completed only half a circuit when a noise emanated from her as if some pneumatic riveters were at work on board. I was so perturbed, that I nearly jumped into the pond after her. Anyway, she had enough way on her to bring her to the side.

I immediately turned off steam and tried the engine by hand. I felt sure that either a piston-rod had come adrift from the cross-head or that a piston was coming unscrewed from the piston-rod and hitting the top cylinder cover. On turning the engine over by hand it moved quite smoothly, but on turning on steam again the engine was immovable but began to dither backwards and forwards. Once again the high and low pressure cylinders were out of time and, I presumed, hence the knocking noise. I began to look around for a sledge hammer, but after having taken the model indoors again and left it for a day or two, I plucked up the necessary courage and for the nth time removed the plant. I was becoming very expert now at that job.

On turning the engine slowly backwards and forwards I noticed the intermediate shaft on the H.P. side moved in jerks which undoubtedly was due to another grub-screw getting loose. This time it was the screw on the gear wheel on the H.P. side, and yet when I tested it with a screw-driver, it seemed reasonably tight. This definitely puzzled me as I knew there was a recess in the



The model H.M.S. "Pandora" with the decks removed

shaft for this grub-screw. There was no help for it, but to take off the gear-wheel. I made a little mark on it so that, if necessary, I could put the teeth in the same mesh as before, and took great care not to move the shaft as I removed it. I immediately noticed that there was no recess where the grub-screw had been, which rather puzzled me.

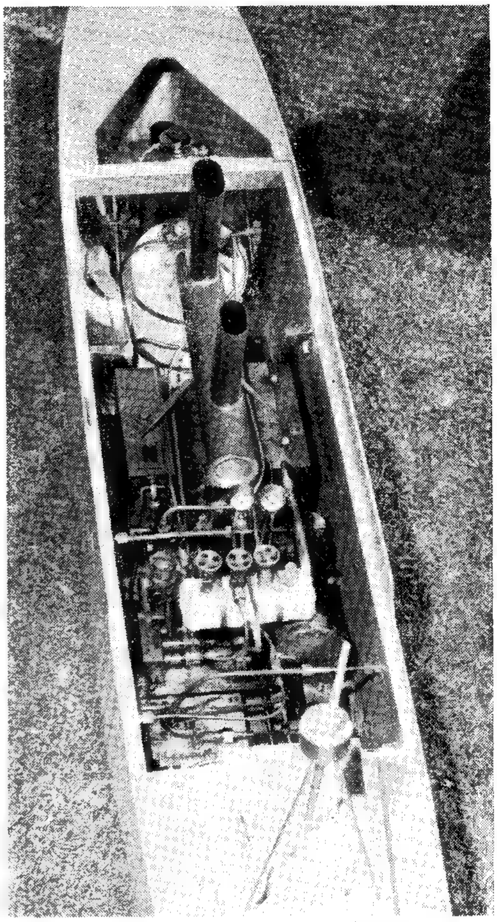
As I had not touched the grub-screw in the gear wheel since setting the cranks and valves as had been recommended by the makers of the big compound in our office, I just could not understand it. There was no help for it but to set it all over again. On turning the H.P. intermediate shaft to get the crank into the right position, the recess came into view. It suddenly dawned upon me what I had done. When setting the H.P. crank to lead the L.P. one I had loosened the grub-screw in the gear wheel, and turned the shaft through an angle of 180° while the gear remained stationary. I naturally screwed the screw up tight and it remained so, but under load it just slipped. Finally, when all was correct the gear-wheel went back at the meshed cogs and the grub-screw into the recess.

The weather then broke and I had to wait for over a week before I could give her another trial run. In the meantime, I started work on the various superstructures.

The next test was one Sunday afternoon when a friend was staying the week-end and, although he was not a model engineer, he was so interested he made me launch her.

After the two preliminary trips, I gave her a good stoke up and making sure that all was well with the fire, the decks were placed on and I sent her off. She was a wonderful sight. Smoke was pouring from her funnels and she steered a course of perfect circles and it gave both myself and my friend a great thrill to see this realistic performance; I felt that all the setbacks that I had and all the troubles I had taken, were well worth while.

I was so fascinated that I clean forgot that H.M.S. *Pandora* was coal-fired and not spirit-fired like all my other models. At about the seventh or eighth circuit, I heard a hissing noise, and then suddenly both engines stopped dead. For a moment I wondered what on earth had happened this time. Was it another one of the troubles in *Pandora's* box? It suddenly dawned upon me. I may be the designer, the builder, the captain, the chief engineer, but I was a very bad stoker! As the latter I had sadly neglected my duties. I was so pleased to see her at last performing as I had sincerely hoped in my dreams, that I had clean forgotten to stoke up.



Another view, showing the plant installed

The Funnel Casings

Part of the fore-bridge which rests on that part of the deck which is removed for firing purposes was made by Bassett-Lowke. I had already made the sides which hide the smoke manifold, but now came the problem of fitting the funnel casings and gratings between them for ventilation. I am an expert in making small gratings, but to make good solid ones measuring 3 in. by 3 in., 3 in. by $1\frac{1}{2}$ in. and 3 in. by 1 in. was a horse of another colour. I had by me some $\frac{1}{16}$ in. by $\frac{1}{8}$ in. strip brass. From this I cut four lengths, the length of the first grating and bored the first hole in one length at the right distance from the end. This was done by holding it in the vice of my sensitive drilling machine. I then made sure that the vice travelled across the table absolutely straight. I then put an odd piece of strip in the vice supporting it on a piece of wood just under $\frac{1}{8}$ in. thick. I finally found that, by giving the traversing handle one and a half turns, the holes were the right distance apart. Then the original strip was inserted and drilling started. The same process went on with the other three pieces, taking care that the first hole exactly corresponded with the first hole in the first piece. I had by me some suitable German-silver wire which was a nice fit in the holes and after cutting a number of lengths longer than required and carefully straightening them up, the process of threading started. The reader can imagine my delight when the threading was completed, and it really looked like the real thing. I made a jig of strips of wood mounted on a piece of wood the exact size of the finished article and placed the two side pieces in position.

When all was ship-shape I ran the soldering iron down both side pieces and on one side of the middle pieces. This done, the grating was removed, and the protruding ends cut with a slitting saw in the lathe. All that remained to be done was to replace the grating in the jig and solder on the end pieces. When finally taken out of the jig to my delight there was the perfect article. They are not difficult to make, they just require patience.

The bases of the funnels were then prepared and using telescopic brass tube for the funnels themselves, cut to the right length, I squeezed it to an oval shape in the vice. The ovals, after having been marked off on the base, were cut out with a metal fret-saw. They required a bit of careful filing in order to give the funnels the right rake. These were then soldered in place. Finally,

the funnels and the gratings were put into place and the lot fixed in position.

Access to Controls

The controls were easily accessible, but the only thing that I did not like was that the pressure gauges appeared above the superstructure. I decided to leave that for the time being and proceeded to make the other two deck-houses, etc. When I screwed the first one in position, I discovered I could no longer get my fingers at the controls ! I let twenty-four hours pass and solved the problem by making a special key which could work the controls from above. I made a flap which could be raised to get at the controls and at the same time I got the idea of building a hood over the gauges and to my mind it looks A.1. All this can be seen in the photographs.

Making the Masts

Undoubtedly, tripod masts were indicated, as they would do away with rigging troubles and also look more the part. The question was not only to make them have the correct appearance, but how to construct them. An old copy of *Model Power Boats* solved the problem. I fortunately had in my material box the right size of thin-walled brass tube and was well away at once. I was delighted with the result. It looked perfect, but when placed in position something seemed wrong. It took me some time to realise my mistake. The funnels on my ship are raked and I had made the mast upright. As the reader can well imagine, the air went blue for miles around ! My good angel was watching over me though, and by altering my rather "Heath-Robinson" jig and being careful with the soldering-iron, I was able to give the mast the necessary rake.

The making of the second one went well, but I just could not get the right rake. I am not sure it is right now, in spite of making many checks. It may be a bit of an optical illusion. There is still a lot to be done to the masts, but I do not anticipate any difficulties.

The Guns

I dare not think too much about the other fittings that must be made, such as Carley floats and some of the guns and the boats, as I am sure I would give up. Writing about the guns, particularly the Barbettes, I think and say it with due caution, I can make them fire semi-automatically. I have made a pair that fire the percussion caps used in children's toy pistols. The principle of the idea, is that I have made the guns to fire these caps using the method of the pea-cannon and holding back the spring with a catch. The gun is fired by releasing the catch. The idea is that, by means of an electric motor and suitable gearing, the turret will revolve through an angle of about 40 deg. and then return to its normal position of fore aft. The trigger, if one can call it such, will release the catches in the guns by being pressed upward on a slope as the turret revolves.

The gearing of the motor is 700 to 1 and the turret will revolve at about the speed of the second-hand on a watch. The operation will be started off by pressing a button or something on the deck as the ship leaves shore and, after the guns have fired, the turret will return to its normal position and the motor will automatically cut out. I have made the guns in brass, and the turret, when turned by hand, works perfectly. Unfortunately, brass is too heavy so I will try and make the guns out of duralumin. My next job is to fit up the electrical part on my experimental turret and see what happens.

Correct Propelling Plant

One other thing that gives me great satisfaction with this model steamer is, that it has once again proved that my ideas on the propelling plant of prototype models is correct. It is only necessary to have a small well-tuned up engine and an efficient boiler to get a reasonably fast moving ship. In this case it is a compound with a H.P. cylinder of $\frac{1}{2}$ in. stroke and $\frac{1}{2}$ in. bore (this cylinder after all is doing the main job), and a low pressure cylinder of $\frac{1}{2}$ in. stroke and $\frac{3}{4}$ in. bore. This type of boiler if I recollect correctly also only steamed a cylinder of $\frac{1}{2}$ in. bore and stroke in the Rogers' locomotive. This model as a matter of fact travels too fast on my little pond, in spite of being on a circular course of thirty feet in diameter, and I am sure she will do a good five miles per hour on a straight course.

I would add that Mr. J. N. Maskelyne has drawn my attention to the fact that the modern "warship" does not emit smoke from the funnels, but H.M.S. *Pandora* looks to my mind much more realistic when she does, and in a way I have achieved a secret ambition of mine and that is to possess a steamer that really smokes and it also proves that I really am already in my second childhood !

That is the story so far, and I trust that all who are interested will wish me luck, and that in due course H.M.S. *Pandora* will be completed and a success.

Fuel Experiment

Since most of the foregoing article was written, I have had a most interesting experience with H.M.S. *Pandora*. As my supply of Craigola steam coal was running short I applied to my friend Mr. C. Courtice for some as he has managed to get hold of a large quantity. When I tried the same in the flash boiler, I just could not get it to burn properly. I used to use in the past, a mixture of Craigola and Warwickshire steam coal in the proportion of three of Craigola and one of Warwickshire, but my supply of Warwickshire had run out. I wrote to our chief engineer at the works, and asked for some more Warwickshire. He informed me he had not got any, but that he was sending me two samples of a similar steam coal, which duly arrived.

Mr. Courtice came and spent a Saturday with me so *Pandora* was put on the pond and the fire started in the boiler. The best that I could get with the Craigola was a dull red-glow. I then added a shovel full of sample No. 1 of the new coal. *Pandora* started to lay a smoke screen, but when I opened the fire-hole there was a mass of flame inside; so I took a chance, turned on steam and let her go.

After two circuits of the pond I stopped her to look at the fire. It was a bright cherry-red. I fired up again using one of the new fuel to three of Craigola. In spite of the "smoke-screen," I let her go. She did about four to five circuits, and when no more smoke appeared I stopped her. The fire was bright cherry-red, and the ship would have been good for several more circuits. Mr. Courtice, and I came to the conclusion that mixing a little volatile coal with a steam coal has the effect of making the steam coal burn better.

Since then, I have had a second trip, and using less blower and with the exhaust of the engine of the water circulating pump, the fire burnt just as fiercely. My next experiment will be with no blower, and I have a sort of feeling that the fire will burn just as well. But on both occasions just mentioned, the ship ran for three-quarters of an hour on a hand-full of coal, but the water was about used up in the supply tanks.

IN THE WORKSHOP

BY DUPLEX

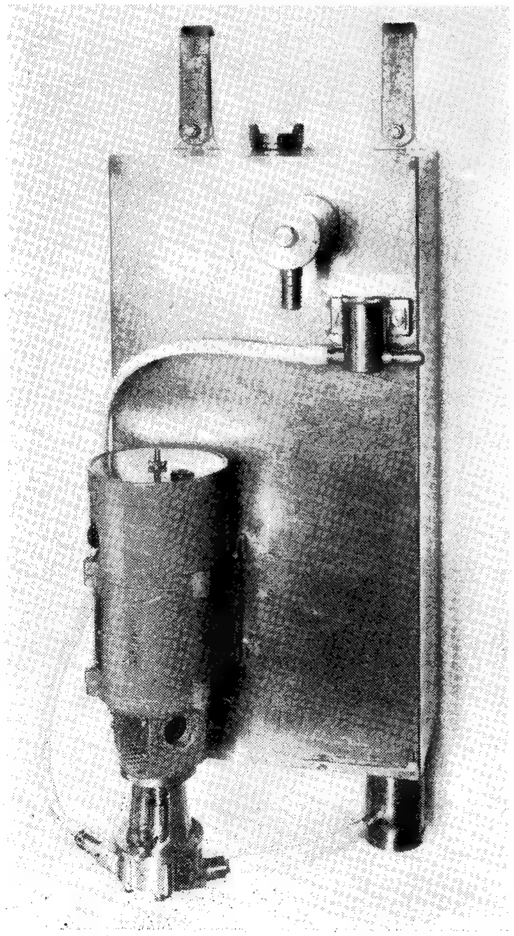
SUPPLYING CUTTING OIL TO THE LATHE

ALTHOUGH, in the small workshop, a drip-can or brush may be found satisfactory for supplying fluid to the lathe tool, much better results will be obtained if a continuous stream of fluid is fed under slight pressure to the point of contact between the tool and the work. The object, here, is to prevent heating by delivering a copious amount of cooling fluid and also to reduce friction by supplying a lubricant. In this way, the life of the tool's cutting edge is prolonged, the formation of a built-up edge on the tool is checked, and distortion of the work from overheating is largely prevented. The material result of all this is that power is saved and a better surface finish is obtained when machining steel and some other metals.

Commercially, soda solution or oils emulsified in water are commonly employed and, as the machines are in constant use, there is little danger of the lathe bed and slides becoming corroded.

In the small workshop, however, where the lathe may be idle for days or even weeks at a time, corrosion and rusting are much more likely to occur if water is an ingredient of the cutting fluid.

For this reason, it is advisable to use one of the proprietary preparations, usually consisting of a mixture of mineral and fatty oils. Plain lard oil, although expensive, can,



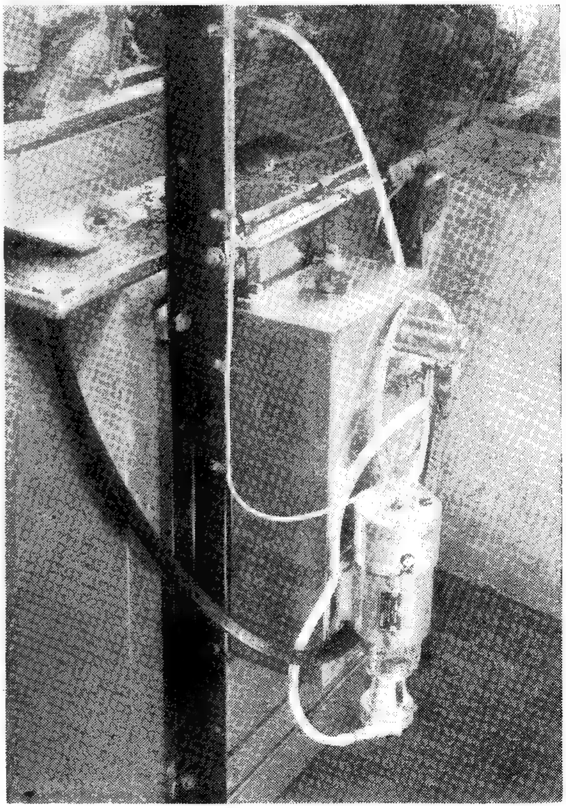


Fig. 2. The pump assembly hung on to the lathe tray

(*Left*) *Fig.* 1. *The pump mounted on the oil tank. Showing the inlet and outlet filters, and the relief valve*

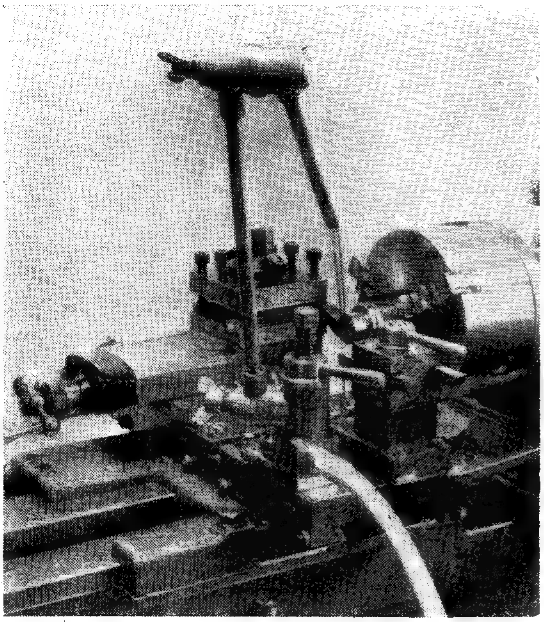


Fig. 3. The hydrant secured to the rear of the cross-slide

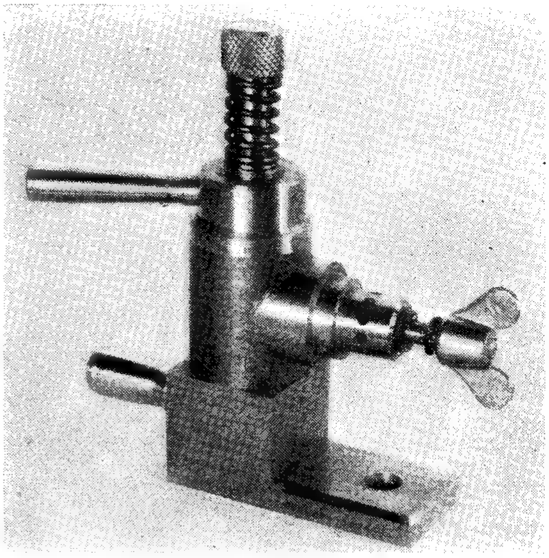


Fig. 5. The base portion of the hydrant

of course, be used for this purpose, but it is of rather too heavy a body to serve as an efficient coolant, and it is also liable to smoke if heavy cuts are taken or if the cutting speed is high. A wide range of Shell cutting oils is available, suitable for a great variety of machining processes, and the manufacturers also issue an admirable booklet on the subject as a guide to machinists. For some time past, we have been using the type of Shell cutting oil known as Makron 15, and this has given excellent results in the circulating equipment here described.

Gear pumps and centrifugal pumps are the types usually fitted to the lathe or other machine tools for circulating the cutting fluid. The small centrifugal pump with electric motor drive, described in a previous article, will serve well for this purpose and the filter and relief valve are also necessary parts of the installation.

As shown in Fig. 1, the pump unit is attached to an oil tank of some three gallons capacity. It is advisable to have a large tank to keep a sufficient quantity of fluid in circulation and to ensure that the fluid is returned before the tank becomes emptied below the level of the pump inlet.

At its lowest point, the tank is fitted with a filter of the type previously described, but the filter should be furnished with a supply pipe, projecting upwards into the tank, in order to keep out sediment. From the outlet of the filter the fluid is led to the inlet nozzle of the pump by means of a length of P.V.C. plastic tubing, which is resistant to oil. This tubing should not be too thin-walled or flattening and kinking may take place at other points on the supply line. Another length of tubing carries the oil from the pump outlet to the relief valve which, again, is of the pattern previously described. Next, the oil passes from the outlet of the relief valve through a long length of tubing to the hydrant or stand-pipe for delivering the fluid to the site of the machining. On its return from the lathe tray, the oil passes through the filter attached to the upper part of the tank and thence back into the reservoir. As shown in Fig. 1, two hangers or hooks are attached to the upper end of the tank so that, as illustrated in Fig. 2, the complete assembly can be hung on to a rail or on to the lathe tray.

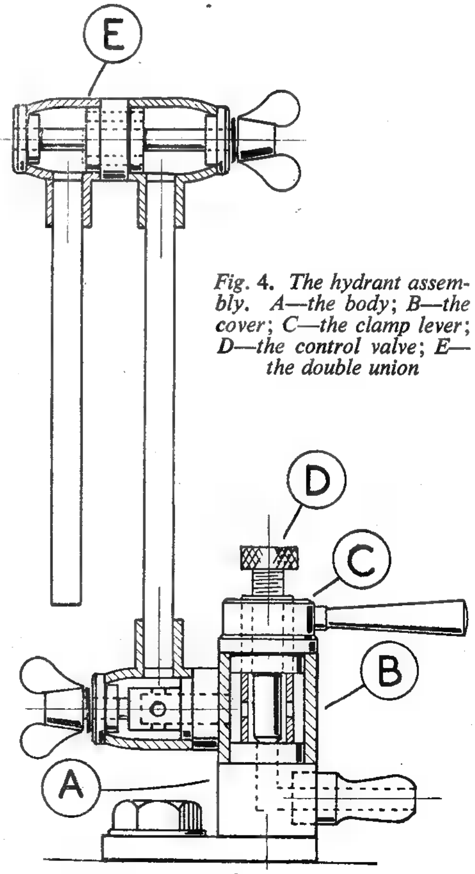


Fig. 4. The hydrant assembly. A—the body; B—the cover; C—the clamp lever; D—the control valve; E—the double union

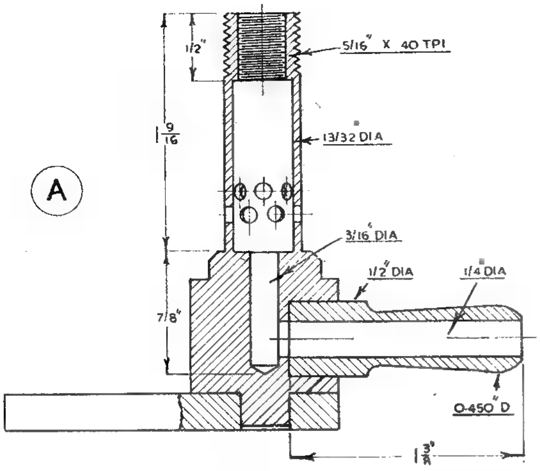


Fig. 6. *Sectional drawing of the hydrant body and fittings*

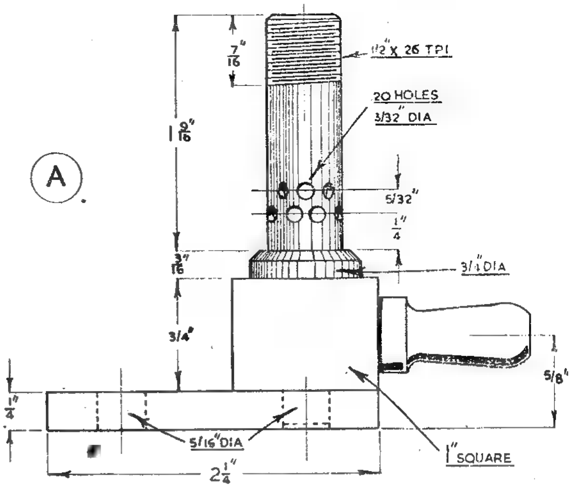


Fig. 7. *Dimensions of the hydrant body assembly*

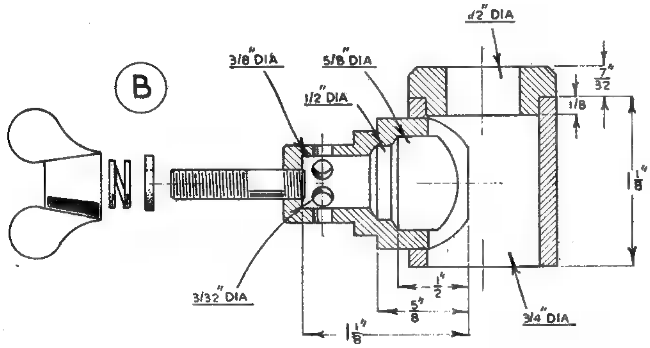


Fig. 8. *The body cover and union*

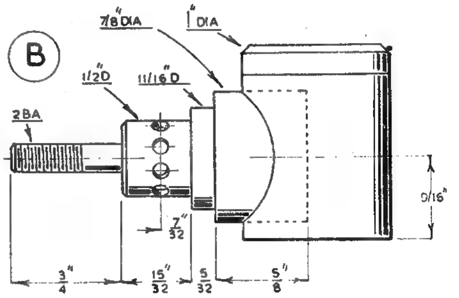


Fig. 9. *Showing dimensions of the cover assembly*

The Hydrant—Fig. 4

As the cutting oil has to be directed on to the point of the tool in contact with the work, the delivery pipe of the hydrant must have universal movement to allow for changes in the position of the lathe saddle or topslide.

In Fig. 3 the base mounting of the hydrant can be seen secured to the rear of the cross-slide, and the screw-down needle valve controlling the output is also shown.

The Body A—Figs. 6 and 7

This part is turned from a short length of 1 in. square steel, brass or duralumin, and a register spigot is formed at the lower end to locate the sole-plate which is attached with two 4-B.A. screws. The inlet nozzle is made an interference fit and is then pressed into place in the vice.

The Cover B—Figs. 8 and 9

The centre portion is machined from 1 in. diameter round material, and the cap collar is made a firm press-fit. The part forming the outlet for the attachment of the pipe leads is also pressed into place and a stud, screwed into the outer end,

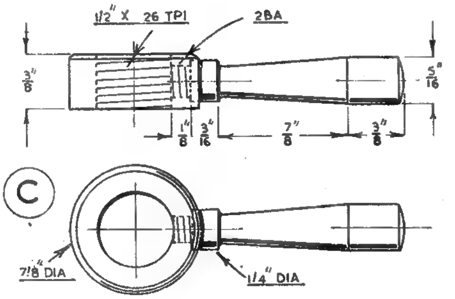
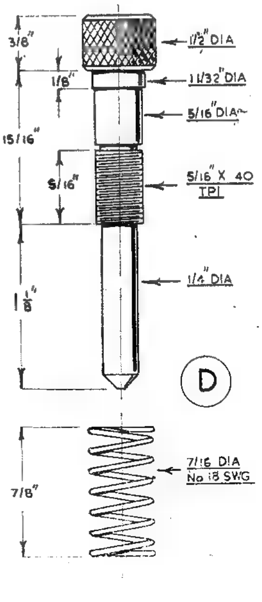


Fig. 10. *The cover clamp lever*



Right: *Fig. 11. The control-valve spindle*

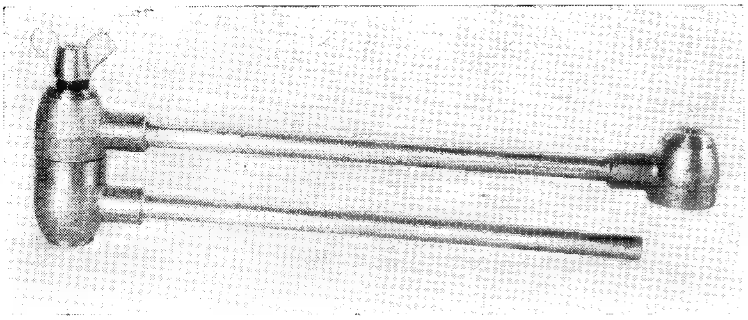


Fig. 12. The delivery pipes and unions

serves to lock the union after the position of the oil pipes has been adjusted.

The cover *B* can rotate on the body *A* and is secured in place by tightening the clamping lever *C*.

The Control Valve D—Fig. 11

This is a screw-down needle valve,

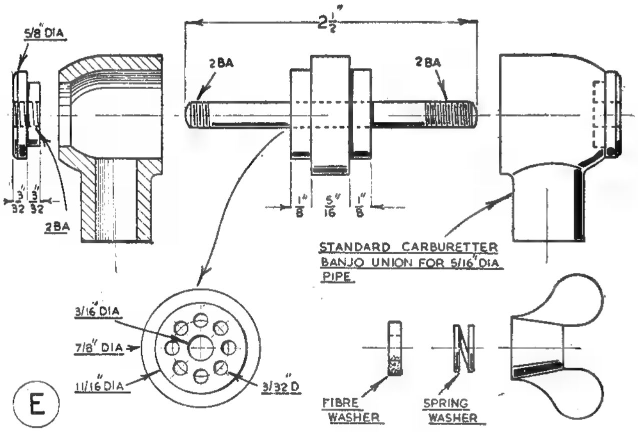


Fig. 13. Details of the double pipe union

formed with a coned tip to engage the flat seating machined within the valve body. Frictional control is provided by fitting a compression spring as shown in Fig. 5.

To prevent oil leakage, it is important to machine all joint surfaces truly flat and square.

The Oil Distribution Pipes

Standard carburettor unions were used for making the movable pipe joints, and the brass tubes were soldered in place.

The construction of the double union fitting *E*, Figs. 4 and 13, is similar to that of the lower union connecting the outflow to the vertical pipe, but in the former a ring of holes is drilled through the flanged distance-piece for the passage of the oil.

Tightening the 2-B.A. wing-nut locks the delivery pipe in place and makes an oil-tight joint.

Returning the Oil to the Tank

Usually, the oil fed to the work is allowed to drip into the lathe tray, where it collects and flows back to the tank, but a small drip-tray can be attached to the saddle to catch the oil and keep an excess, as well as the swarf, from reaching the working parts of the lathe.

From the lathe tray, the oil passes through a union for attaching the plastic tubing which serves to return the fluid to the tank. This union, Fig. 14, is castellated at its lower edge and keeps back the larger forms of swarf.

To prevent an air-lock forming, a disc of wire gauze is fitted to the cap of the union body.

Splash Guards

When a watery solution is used for machining, the cutting fluid is liable to be flung outwards, to the detriment of the workshop and the operator's clothing. On the other hand, this tendency is much less marked with cutting oil, and usually there is no splashing at ordinary turning speeds, unless the oil reaches the chuck jaws. However, to be on the safe side, a guard can be permanently fitted in place at the back of the lathe to catch any splashings and drain them into the tray.

As a shield fixed to the front of the lathe will interfere with operating the machine, this guard is best fitted with a footing to stand in the lathe tray and allow of quick removal.

Avoiding Skin Trouble

Some people have a skin that is very sensitive to the oils used in the preparation of cutting fluids, particularly if these contain free sulphur, and, if care is not taken, an unpleasant, itching rash may develop on the hands and other exposed

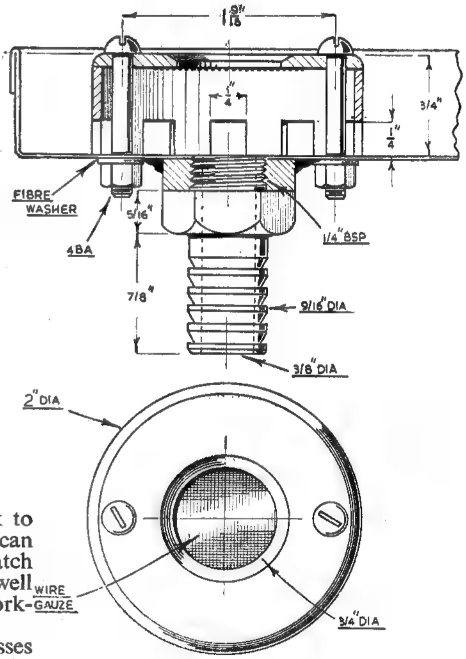


Fig. 14. The lathe tray outlet union

parts. Those liable to be affected in this way may find it helpful to treat the hands with one of the commercial barrier creams before starting work. In any event, it is advisable, after work, to remove all traces of cutting oil from the hands with ordinary toilet soap and warm water.

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

P.S. "VICTORIA"

DEAR SIR,—The news in a recent issue of THE MODEL ENGINEER that the old paddle steamer *Victoria* is to be broken up reminded me that I took a photograph of her in 1948. We were on the cliffs on the seaward side of Lulworth Cove when this dainty little ship came steaming up the coast. We did not expect it to enter the cove and were most surprised when it boldly steamed in through the narrow entrance and made for the western shore of the cove. Just before lightly grounding the bows she dropped a line astern which secured to a buoy by a dinghy.

The photograph shows her going astern to check way just before grounding the bows. There is steam on the after capstan and the board (gangway if you like !), which is connected up to the bows when disembarking and embarking passengers can be seen on the beach on the extreme left of the photograph.

Yours faithfully,
Bourne End. G. S. BROWN.

THE HICK OSCILLATING ENGINE

DEAR SIR,—I was interested in "Northerner's" reference to the model of the above engine made by Mr. J. Shaw of Oldham, which certainly appears from the photograph to be a great credit to the skill of a youth of 17 years of age.

I am somewhat surprised, however, that he makes no reference to the source of the design, which was obviously a set of drawings published by the Precision Models Co. of Byfleet, Surrey, who probably also supplied the castings.

As the one who produced these drawings for the Precision Models Co., and as one who loves accuracy in historic models, let me say that I, personally, completely agree with "Northerner" on the desirability of cast-iron for the flywheel and many other parts. Knowing, however, that many model makers of quite high repute prefer to use other and more showy materials, I compromised on the drawings by giving alternative materials. Reference to the drawings will show that in this case I put cast-iron first on my list as the preferred material. I believe the Precision Models Co. had some difficulty in procuring satisfactory iron castings, which probably accounts for Mr. Shaw's use of brass.

With the exception, noted on the drawings, of the rather drastic alteration of the internal arrangements of the valve, I believe the engine to be a very correct replica of the original, and a number have been made both in this country, the U.S.A. and in Canada.

The original engine was not only shown at the 1851 exhibition, but was under steam there, where it drove a "Ryder" forging machine, a type of machine still sometimes found in service.

Yours faithfully,
Norwich. GEOFFREY K. KING.
A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.I.

PLASTIC KNOBS

DEAR SIR,—If your querist, D.O. (Greenford) in the issue of 12/11/53 is not particular about new appearance, or size, he will obtain all the knobs he requires from his local car breaker's yard for a very nominal sum. These come off the gear levers of old motor-cycles and cars.

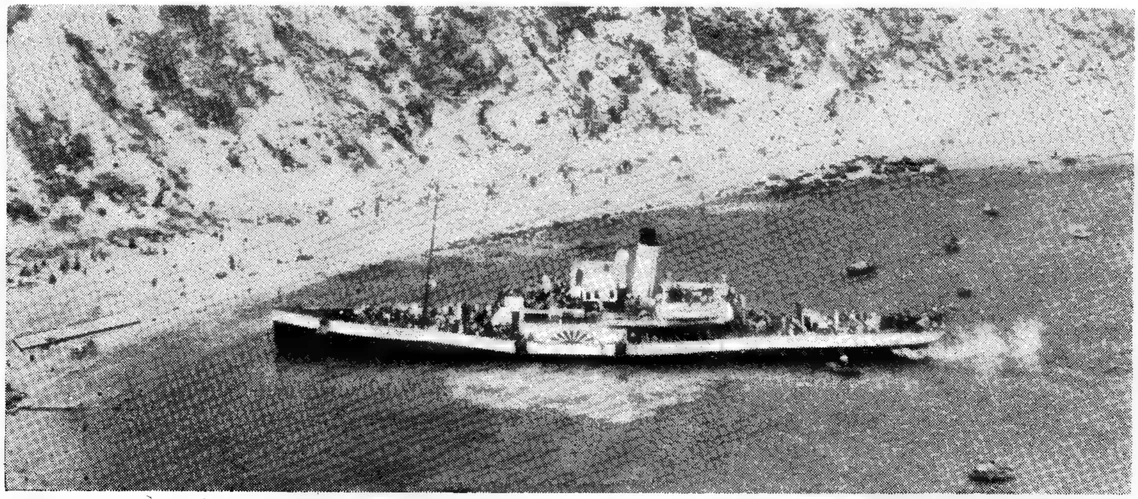
If appearance is of importance, he will obtain the same knobs new at any large dealer in car and/or motor-cycle spares.

Yours faithfully,
Wembley. W. H. RIDER.

DEAR SIR,—In the reply to reader "D.O." of Greenford, page 588 of the 12th November, 1953 issue of THE MODEL ENGINEER, I notice that you were unable to offer any advice about retail suppliers of plastic knobs for machine tool levers, etc.

It is my impression that Messrs. Buck and Ryan of 310-312, Euston Road were offering such commodities for sale on their stand at the last "M.E." Exhibition, and an enquiry by "D.O." would doubtless confirm whether this firm continue to retail such articles.

Yours faithfully,
Ruislip. G. W. WILDY



L.B.S.C.'s *Titfield Thunderbolt*

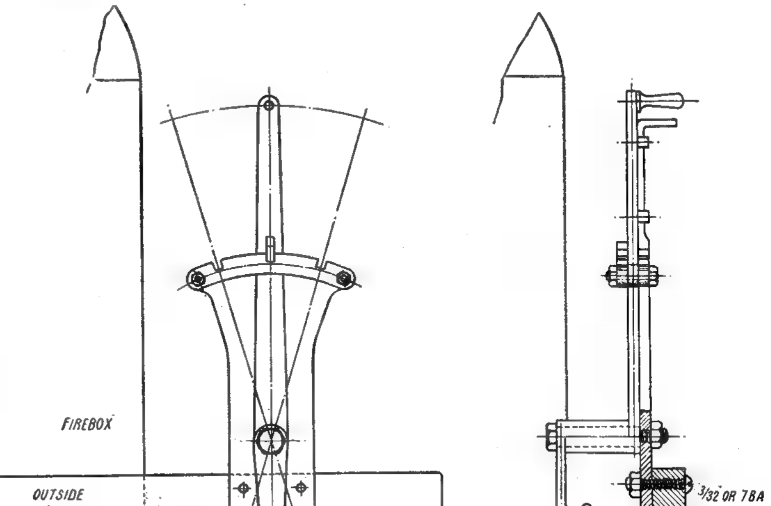
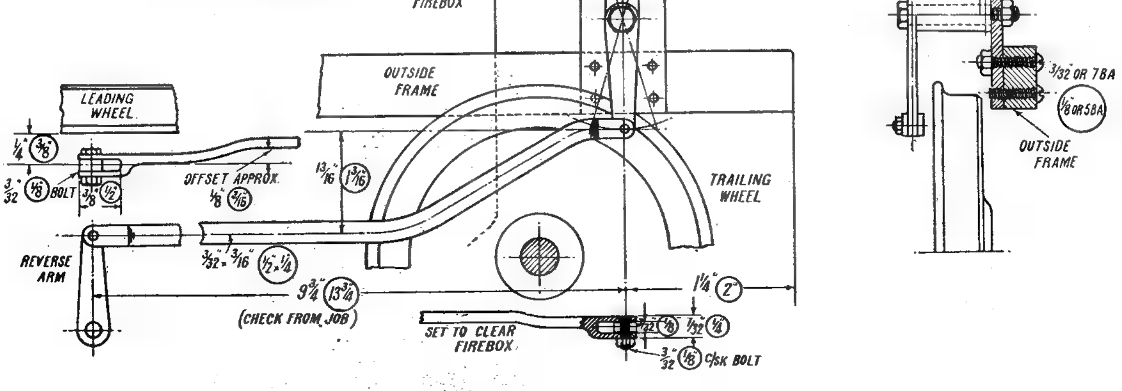
IN 3½ AND 5 INCH GAUGES

MY drawings of the full-sized *Titfield Thunderbolt* don't show any details of the reversing lever; so I looked up some details of similar engines in Warren's book, *A Century of Locomotive Building*, only to find that we are up against the same old trouble ! Most of the levers shown in the drawings in the book, have a quadrant and sector-plate that bears a resemblance to the spring traps used by poachers in the days of long ago, the lever being pivoted to the frame, and working between the jaws of the " trap." In most of the illustrations, the reach-rod is shown attached to the lever above the pivot or fulcrum-pin, and goes down to the arm on the weighbar shaft, by different ways, according to the position of the shaft. In some cases, the connections are made so that the engine runs in the opposite direction to the inclination of the lever. This makes it very awkward for a driver who doesn't always have the same engine. In one case on record, an appalling accident occurred, owing to a driver, in a dense fog, putting his engine into what he thought was forward gear, after a signal stop, and didn't realise that the train was running backwards until it collided with the following train.

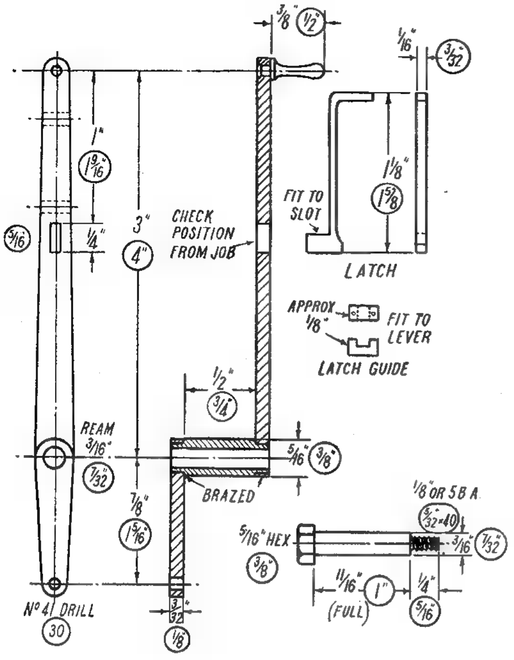
As it would be useless to copy the " spring trap " arrangement in the small size, I have grabbed the bull's horns once more, and combined an old-fashioned type of lever with a simple plate stand, which is easy to make and erect. It is also arranged that the engine goes ahead when the lever is pushed forward, and vice versa. The whole bag of tricks is shown in the general arrangement drawing. The stand, or sector-plate, which may be cut from steel or may be cast, is bolted to the frame just behind the trailing wheel. On the full-sized job, when the lever was in forward gear, it went right past the backhead, alongside the firebox. This is not so good on a little engine, as the lever would come too close to the hot plates, to be comfortable; and I'd just hate to think of the naughty things that the worthy bishop might be tempted to say, if he burnt his ecclesiastical fingers on the hot metal, and had to hold them in a pail of cold water, all the way from Titfield to Mallingford Junction ! The arrangement is the [illegible] on both the 3½-in. and 5-in. gauge engines, and all dimensions for both sizes, are shown on the drawings.

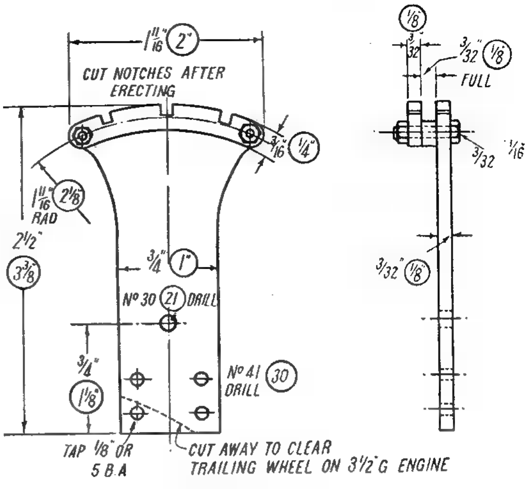
Stand or Sector-plate and Reverse Lever

If a casting is used, it will only need cleaning up with a file, and the holes drilled for the bolts and fulcrum pin. If steel plate is used, simply saw and file to outline shown, using ⅛-in. sheet for the 5-in. gauge

Arrangement of reverse lever and connections





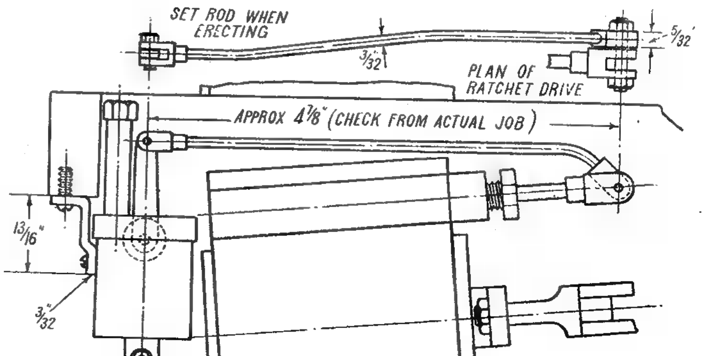
Stand for reverse lever

***Left*: Details and dimensions of the lever**

engine, and 3/32-in. for the smaller one. The quadrant or retaining plate, can be cut from similar metal, and can be used with either cast or sheet-metal stand. The spacers are made by chucking a piece of round rod in the three-jaw, drilling it correct size for bolts (No. 51 drill for $\frac{1}{16}$ in. and No. 41 for 3/32 in.) and parting off slices to full thickness, so that when the quadrant is bolted to the sector-plate, the lever is free to move back and forth, with no side wobble. Don't file any notches until after the complete doings is erected. Note that the 3½-in. gauge stand has to be filed at the bottom, to clear the trailing wheel.

To erect, clamp the stand at the right distance from the trailing end, *outside* the frame; the correct location is shown in the drawing. Using the holes in the bottom of the stand as guide, drill clean through the frame. Three holes only are needed on the 3½-in. gauge engine; on the 5-in. there is an additional tapped hole as shown. Drill this one with a No. 41 drill, and open it out to No. 30 after removing the stand. The corresponding hole in the stand, has to be tapped, because a nut cannot be put on between the trailing wheel and the frame. File off any burring, put the stand in place on the inside of frame, and fix with bolts as shown.

As the lever is nothing more than a glorified edition of the valve-gear rockers, there is no need to waste space on a fully detailed description. Both lever itself, and drop arm, are just plain sawing-and-filing jobs; be careful to get the slot for the latch in the right position. The sleeve is a piece of mild-steel rod, drilled and reamed for the fulcrum pin, and turned down at each end to fit the holes in the larger end of the lever and arm; the lot is assembled and the joints brazed, same as described for the rockers. The trigger and latch are filed from one piece of metal, to dimensions shown; this is held to the lever by two guides, also shown, which are riveted to the lever by very small rivets. Bits of domestic pins do fine for jobs like this. No spring is necessary, the weight of the latch and trigger being sufficient to make it drop into the notches. The handle or grip is turned from round mild steel, a pip being left on the end, which is pressed into a drilled and countersunk hole in the top of the lever, and riveted flush. The fulcrum pin can either be turned from hexagon mild-steel rod, or



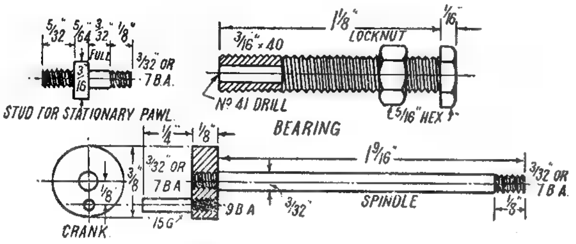
Arrangement of mechanical lubricator for 5-in. gauge engine

made from round silver-steel of the requisite diameter, the head being formed by reducing the end and screwing it to the same size as the opposite end, and fitting a nut.

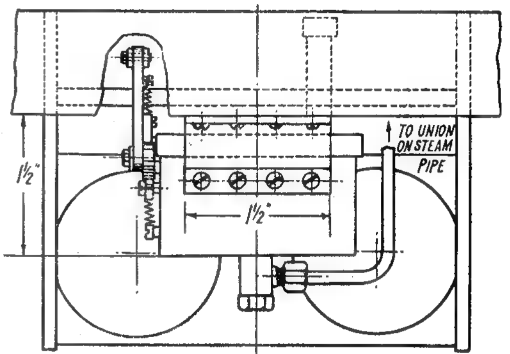
To assemble, just remove the quadrant plate, attach the lever to the stand by the fulcrum-pin, and replace the quadrant, making sure that the lever works freely without being slack.

hasn't got ! " When first making the drawing, I wondered how on earth I could arrange a simple drive, without adding extra complication in the shape of another rocking lever and divided rods, an arrangement which was unavoidable on my *Grosvenor*; the problem was solved in a very easy manner, by turning the ratchet lever upside down, and connecting it to the top

$2\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. wide, nicking a $\frac{1}{4}$ in. square out of each corner, bending them over to form a tray, silver-soldering the corners on the Cohen-McPherson principle, so that the lid goes right on. Fit a bit of $\frac{1}{4}$-in. pipe in the lid, to act as filling tube; this can be soft-soldered or silver-soldered, just as you like. Turn a plug to fit the top, just a push-in fit.



Lubricator details, 5-in. gauge engine



Right: How to erect the lubricator, 5-in. gauge engine

Reach-Rod or Reversing-Rod

The reach-rod, or reversing-rod, is made from steel strip of the size shown on the drawings, and has a thickening block brazed on at each end, which is drilled and slotted in the manner described for valve-gear forks. It will require setting out a little, to clear the firebox, and setting in again at the front of firebox, to clear the wheels and bring it into line with the reverse arm on the weighbar shaft. Set the rod temporarily, as shown, and final adjustments can be made after the boiler is erected. It will probably be found that in full back gear, the bolt attaching the fork to the top of the reverse arm, hits the edge of the inside frame. If so, please don't waste time in writing me a four-page foolscap letter, telling me what a wretched designer I am (I know that already !), but with a round file, make a little clearance in the frame edge, just big enough to accommodate the head of the bolt, and then we shall both be quite happy.

Only three notches are needed in the sector-plate, one in the middle, and one at each end, at the position of the lever when the gabs are right home on the pins. They can be carefully hand-filed, and should be wide enough to allow the latch to drop in easily, but not enough to let the lever rattle.

Mechanical Lubricator

This gadget certainly *is* " a little bit of something that the big one

of the rocking lever on the right-hand side, by a rod attached to the bolt through the valve-spindle fork, the rod passing over the top of the steamchest. The union on the check-valve under the oil tank, points to the side of the engine, instead of to the back, as usual, and the oil pipe goes up at the side of the lubricator, joining the steam-pipe just above the point where steam enters the steamchest.

As the $3\frac{1}{2}$-in. and 5-in. gauge lubricators differ a little in detail, I'll follow the same procedure as with the valve-gear and other parts, and give separate drawings, by kind permission of the K.B.P.; so here are the drawings and notes for the 5-in. gauge engine. As the lubricator is of my " standard " type, there is no need to " make a meal " of the description, as full details have been given several times already; too many writers are prone to use twenty words where one would do ! The oil tank is made by bending a strip of 20-gauge metal, 6 in. long and $1\frac{1}{2}$ in. wide, into a rectangle measuring 2 in. × 1 in. standing it on a piece of 16-gauge metal, a little larger than 2 in. × 1 in. and brazing or silver-soldering all around the bottom, and in the corner joint. File the bottom edges flush with the sides, and drill a 7/32-in. hole in the middle. Drill a $\frac{3}{16}$-in. hole for the bearing, on the centre-line of one of the short sides, $\frac{3}{16}$ in. from the top. The lid can be made by cutting out a piece of 20-gauge metal

Oil Pump

Both the pump stand and cylinder are made from $\frac{5}{16}$ in. square rod, bronze or gunmetal for preference, although hard brass will do at a pinch, as the whole lot runs in oil, and wear is negligible. Note that I have made a slight variation in the stand, which has a spigot that goes through the bottom of the tank, is held by the body of the check-valve, and forms the ball seating. To make the stand, chuck the rod truly in the four-jaw, face the end, turn $\frac{3}{16}$ in. full length to 7/32 in. diameter, and screw 7/32 in. × 40. Centre, run a No. 34 drill in to $\frac{3}{8}$ in. depth, ream $\frac{1}{8}$ in. and skim the end true. Part off at $1\frac{1}{4}$ in. from the shoulder, and cut the rebate, and the recess, either by milling, or careful filing. Drill and tap the $\frac{3}{16}$-in. × 40-hole for the bearing, and drill the No. 41 hole for the trunnion-pin, and be mighty careful that both these holes go through dead square with the contact face. Form a recess $\frac{1}{8}$ in. deep, around the trunnion hole at the back of the stand, with a $\frac{1}{4}$-in. pin-drill. Drill the right-hand port slightly at an angle, as shown in the section, so that it breaks into the hole in the spigot. Drill the left-hand port in $\frac{1}{16}$ in. only, and chip a small groove from it to the bottom of the stand, as shown. A weeny chisel made from a scrap of 3/32-in. silver-steel, will do this job very well. Note—and this is *very* important—that the distance between the inner edges of the ports, must

not be less than $\frac{1}{16}$ in. so that the port in the pump cylinder cannot bridge them. Failure to space the ports properly, has caused more than one beginner to wonder why the oil tank became full of water instead of oil, and no oil went to the cylinders. The reason was, that a leaky check-valve allowed steam to blow back along the pipe, get from one port to the other when the cylinder port bridged them, and condense in the tank, throwing the oil overboard. The contact surfaces must be truly faced, as described for slide-valves and cylinder portfaces.

To make the pump cylinder, part off a $\frac{5}{8}$-in. length of $\frac{5}{16}$-in. rod. Make a centre-pop on one end at $\frac{3}{16}$ in. from the edge (see plan), chuck in the four-jaw with this mark running truly, open it with a centre-drill, and put a No. 34 drill right through. Further open out to $\frac{3}{16}$ in. depth with $\frac{3}{16}$-in., drill, and tap 7/32 in. × 40; put a $\frac{1}{8}$-in. parallel reamer through the remains of the 34 hole. Make a gland from $\frac{1}{4}$-in. hexagon rod as shown. the threads of which should be a fairly tight fit, and turn up a wee plug for the bottom, which should be a press fit. If there is any suspicion of slackness, solder over the head.

The port is drilled with No. 54 drill, to break into the bore. The hole for trunnion pin is drilled No. 48, and tapped to suit the pin; it shouldn't pierce the bore, and it must be dead square with the contact face, or oil will leak between the sliding surfaces. The trunnion-pin is made from 3/32-in. silver-steel, to dimensions as shown, and should be tight enough to avoid any chance of coming adrift in service. The ram, or plunger, is made from $\frac{1}{8}$-in. round silver-steel, reduced at the end to 5/64 in. and screwed 9 B.A.; a little big-end (says Pat) is filed up to the shape shown, from $\frac{1}{8}$-in. brass, drilled and tapped 9 B.A. in the thickness, and screwed on tightly. If there is any slackness in the threads, silver-solder it. Pack the gland with a strand of graphited yarn, and assemble as shown. One last reminder; the contact surfaces MUST be truly faced before assembly. It is surely easy enough to rub them on a piece of fine emery-cloth, or similar abrasive, laid on the lathe bed, or something equally flat and true. A *polished* surface is *not* needed; the matt surface left after the treatment referred to, is the finest possible for keeping the faces leakproof. Neither is a great spring-pressure required; if the spring starts to compress just before putting the nut on, it will hold the faces in contact, tight enough to withstand the pumping pressure.

The body of the check-valve or clack, is formed by a tapped bush $\frac{7}{16}$ in. long, made from $\frac{5}{16}$-in. round brass rod, drilled $\frac{3}{16}$ in., tapped 7/32 in. × 40, and faced off at both ends. A $\frac{1}{4}$ in. × 40 union nipple is silver-soldered to the middle as shown; and a 7/32 in. × 40 plug, made from $\frac{5}{16}$-in. hexagon rod, drilled to receive the spring, closes the end after assembly.

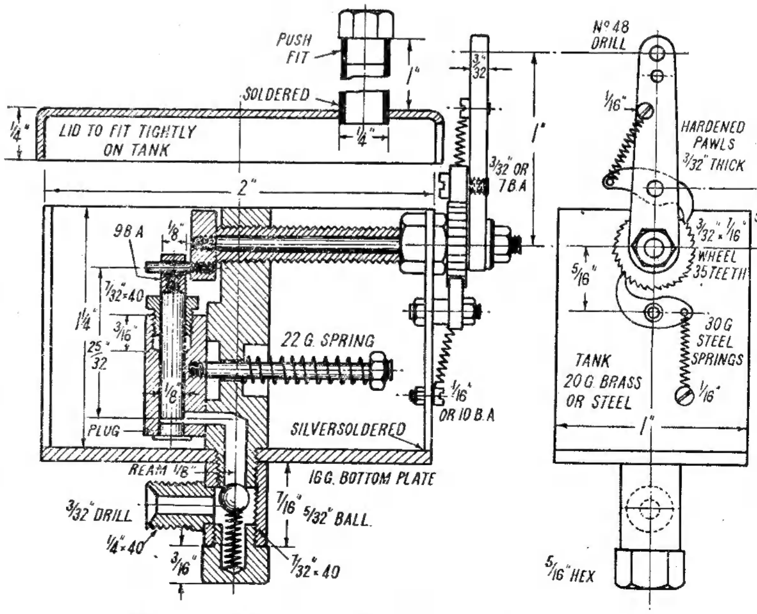
The pump spindle is a piece of 3/32-in. silver-steel rod, $1\frac{11}{16}$ in. long, screwed at both ends. One end carries the crank, which is a $\frac{1}{8}$-in. slice of $\frac{5}{8}$-in. round rod, with a tapped hole in the middle to suit the spindle, and a crankpin made from 15-gauge spoke wire, screwed 9 B.A. set in it at $\frac{1}{8}$ in. off centre.

The bearing is made from $\frac{5}{16}$-in. hexagon rod. Chuck in three-jaw, face, centre, drill No. 41 for $1\frac{1}{4}$ in. depth, turn the outside to $\frac{3}{16}$ in. diameter for $1\frac{1}{8}$ in. length, screw $\frac{3}{16}$ in. × 40, and part off at $\frac{1}{16}$ in. from the shoulder. Reverse in chuck, chamfer slightly, and make a lock-nut to fit the screwed part, from the same sized rod.

Put the stand, with cylinder attached, in the tank, the spigot going through the hole in the bottom plate, and screw the clack body on, just finger-tight. Push the bearing through the hole in the side of the tank, put on the lock-nut, and screw the bearing into the hole in the top of the stand, until the head of the bearing touches the side of the tank; then run the lock-nut back against the tank side, and tighten up. The clack body can then be tightened; when right home, the nipple should point to the side opposite the bearing, as shown. If it doesn't, don't force it enough to strip the thread, but take a wee bit off the end next to the bottom of the tank. When right home, seat a 5/32-in. ball on the end of the reamed hole in the spigot, and fit a cap with a blind hole drilled in it, as shown, to accommodate a light bronze spring, which will keep the ball on its seating when the pump ram isn't forcing.

Ratchet Gear

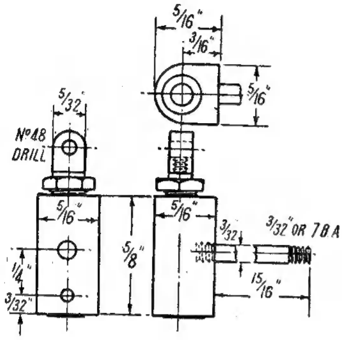
Our advertisers sell ratchet wheels, but if you prefer to cut your own, to ensure evenly-spaced teeth of proper depth, follow the instructions given in these notes last week. If the hole is drilled No. 43, the wheel should be a press fit on the spindle, and need no further fixing; be sure to get the teeth the right way around, as shown in the drawing. Press the wheel on to the spindle until $\frac{1}{4}$ in. of same projects, then try it in the bearing, holding the crank, opposite the end of the bearing, and screwing the spindle into it. When right home, there should be just the slightest bit of end play; if too tight



Section and end view of lubricator—5-in. gauge engine

or too slack, adjust position of wheel on spindle.

The ratchet lever is filed up from 3/32 in. × $\frac{1}{4}$ in. steel strip, to the shape shown; the hole for spindle is drilled No. 41, those at the small end No. 48, and the hole for the pawl screw drilled No. 48 and tapped 3/32 in. or 7 B.A. If the pawls



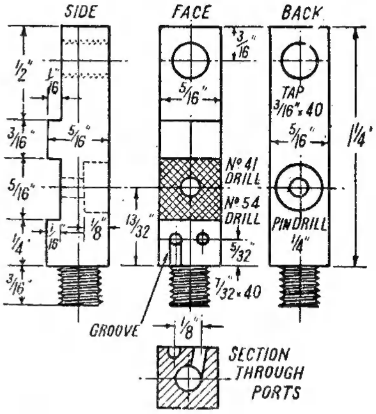
Oil pump cylinder, 5-in. gauge engine

are filed from gauge-steel (ground flat stock) harden and temper them to dark yellow; if of mild-steel, case-harden them as previously described for valve-gear parts and so on. The moving pawl is attached to the ratchet lever by a screw having a full 3/32 in. of "plain" under the head; this can be turned from a bit of $\frac{3}{16}$-in. steel, round or hexagon. When right home, the pawl should be quite free, without being slack. The stationary pawl is mounted on a stud, shown in the detail drawing, also turned from $\frac{3}{16}$-in. rod; the fully-screwed end goes through a hole in the side of the tank, and is secured by a nut, as shown in the section. Both pawls are controlled by springs wound up from 30-gauge steel wire (piano wire will do ; I've used mandoline strings, broken too short for their legitimate use) the outer ends being anchored by $\frac{1}{16}$-in. or 10-B.A. screws, as shown. When the lever is put on, next to the ratchet wheel, and secured by a nut and washer, it should be free to swing on the spindle, without side shake, when the nut is screwed tightly home to the end of the thread. Put a drop of oil in the tank, and waggle the ratchet lever until oil appears at the union nipple; then put your thumb over the nipple, and continue waggling. If the workmanship is O.K. it will be found impossible to prevent oil coming out of the nipple, no matter how hard you press.

How to Erect the Lubricator

Bend up a bracket from a bit of 3/32-in. or 13-gauge sheet metal, $1\frac{1}{2}$ in. wide, to the shape shown in the assembly and erection drawings. Attach this to the tank in the position shown, by four 3/32-in. or 7-B.A. screws, either nutted inside the tank, or screwed into tapped holes in a strip of brass soldered inside the tank. The bracket is then fixed to the underside of the buffer beam, by four similar screws, in the position shown in the drawing. Looking at the front of the engine, the ratchet gear should be to your left. This bracket will hold the lubricator quite firmly.

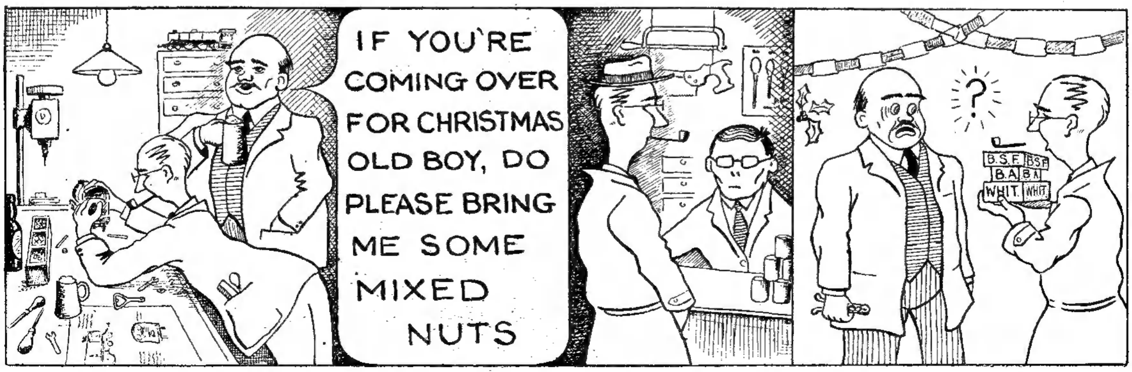
The ratchet lever is driven by a 3/32-in. rod, attached to it by a fork made from $\frac{3}{16}$-in. square steel, by same process as valve-gear forks, which is "ancient history" to regular readers of these notes ! The bolt can be made from 15-gauge spoke wire, screwed 9 B.A. at both ends and nutted. At the opposite end, the rod is screwed into a "big-end brass," filed up from any odd scrap of suitable size, and drilled No. 30, to fit over an extension of the $\frac{1}{8}$-in. bolt which passes through the valve-spindle fork, and holds the



Oil pump stand, 5-in. gauge engine

die-block in place at the top of the rocking-lever. The moving pawl should click one tooth per waggle of the lever; any adjustment needed, can be made at the fork end, by screwing same on or off the rod. There is no need to bother about the oil pipe until the boiler is made and erected, as it will be connected to a union nipple attached to the fitting which is screwed into the steamchest cover, and carries the nipple for the superheater union. All being well, drawings of the $3\frac{1}{2}$-in. gauge lubricator will follow shortly; meantime we will have to see about putting the kettle on.

NUTS—and *Crackers !*   *By Pete E.*



QUERIES AND REPLIES

" THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked " Query " and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

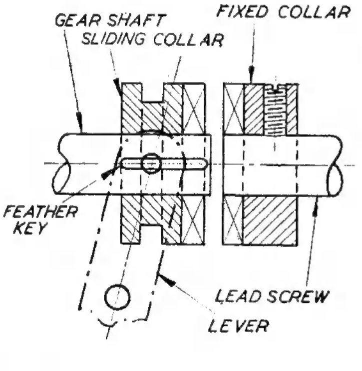
Leadscrew Clutch

I have fitted my Super Adept Lathe with a self-acting feed for working through reduction gears and tumbler reverse. I should like to be able to stop the feed without stopping the machine or shifting the tumbler gears so as to enable the hand feed to be used without driving the train of gears. Will you please describe some method of doing this?

I understand that the usual device is a clutch on the leadscrew driving shaft.

A.M. (Motherwell).

In the case of lathes which are not fitted with a split clasp-nut for the purpose of disengaging the saddle feed, it is usual to fit a simple form of dog clutch in the drive to the leadscrew. The usual arrangement



is as shown in the sketch, in which the extension shaft is fitted in line with the leadscrew and equipped with a simple form of sliding dog clutch with some means of operating it while the lathe is running, such as a lever with a pin or fork, as shown. In cases where the gearing is used for screw-cutting purposes, the clutch must be arranged so that it has only one position of engagement per revolution, as otherwise there is liable to be difficulty in picking up the threads correctly after the clutch has been disengaged.

Grandfather Clock Movement

I have acquired an old grandfather clock made by William Northrop, and there are one or two points on which I should appreciate advice.

First, what is the correct method of attaching the movement to the seating board in the clock case? Should there be hook bolts over the two bottom pillars? In my clock someone in the past has fixed a cheap and nasty hinge to the movement, so that it can be swung upwards and backwards.

Second, the date dial has 62 teeth on its edge, and these presumably, engage with a pin on the hour hand arbor. Is it necessary to adjust the dial by hand for the different number of days in the month? It would appear that the dial has had two pins diametrically opposite each other at the back. Should these be refitted, and what length should they be? I can see no purpose for them, but there may possibly be some other parts missing.

R.M. (Sierra Leone).

A very common method of mounting the movement in grandfather clocks was by means of two or sometimes more hook bolts over the bottom two pillars as you suggest. There have been, however, other methods employed, though we have not seen a hinge used in the manner you describe.

With reference to the date movement, the type of dial you describe is usually driven by a single tooth on the hour arbor, so that it moves the dial forward one tooth for every 12 hours. It thus completes a rotation in 31 days, and in the case of months having less than 31 days, it is necessary to make the necessary adjustment by turning the dial by hand on the first day of the following month.

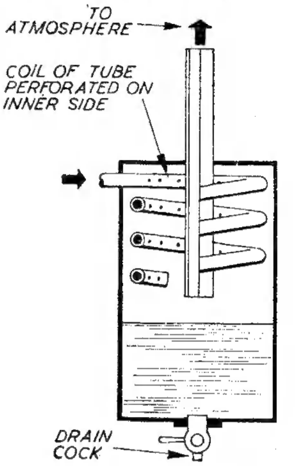
We do not know the function of the two pins on the back of the date dial, and it appears rather unlikely that they could have been intended for driving some other part of the mechanism which at present is missing.

Exhaust Steam Separator

Can you please advise me of any method of separating oil from the exhaust steam of the power plant of a model tug, as I find that the oil blown out from the exhaust makes the deck fittings of the boat very dirty.

R.C.J. (London, N.22).

We publish here a sketch of a very simple separator which we think you will find quite effective.



The separator vessel will need to be fitted with a drain tap, so that it can be emptied at frequent intervals, but if necessary, this drain can be kept slightly open all the time so that it is continuously blown down to a suitable drain tank in the bilge of the boat.

Pistons and I.C. Engines

Could you advise me as to the correct method of making model locomotive pistons? Do they have rings fitted, or are they a good fit in the cylinders? Also, can you tell me where I can obtain drawings for a 10 to 20 c.c. four-stroke petrol engine?

J.A.C. (Erdington).

A simple method of making small locomotive pistons is to turn a solid head a good sliding fit in the cylinder and screwed to the end of the piston-rod. About half-way along the head, cut a deep groove about $\frac{1}{8}$ in. wide and pack it with graphited-yarn. " L.B.S.C." has described this method many times.

We can supply drawings for 4-stroke o.h.v. petrol engines, of 10 to 20 c.c. capacity. These are the well-known Westbury engines, " Kiwi," " Kittiwake " and " Apex Minor." The first is 3s. 6d. the other two 2s. 9d. each, including postage, from our Sales Department

Rocket Motors

I am proposing to experiment in making small rocket motors, and for the parts which have to withstand high temperature I propose to use tungsten, although it is expensive, because it has an extremely high melting point (3,367 *deg. C.*). *The fuel employed will be pure hydrogen. Can you give me some details on the practicability of using tungsten as described.*

The framework of the rocket is designed to be made of aluminium, in flat sheets, and tubes. What is the best way to fix the skin into the structure ?

M.J. (Portsmouth).

We are very surprised at your intention to make a motor out of tungsten as, quite apart from the expense of this material, its working, whether by machining or any other method of fabrication, would be extremely difficult, if not impossible.

Generally speaking, tungsten is only used in very small pieces of simple shape, such as contacts for electrical apparatus, which are usually formed by compressing the material in dies and sintering at high temperature.

We have no exact particulars regarding the physical properties of the metal, but it is used very extensively for alloying with iron and other metals to produce tool steel which will resist high temperature.

With reference to the construction of the rocket framework, we cannot advise you definitely on this point unless we have full particulars of the constructional design.

5-in.-Gauge " Titfield Thunderbolt "

It is with great pleasure that I undertake the building of " L.B.S.C.'s " " Thunderbolt " (*or* " *Lion* " *to me*). *As an ardent admirer of your valued contributor, I would be very pleased if it were possible to give a dimensioned sketch of the 5-in. gauge engine's inside frames, as the 3½-in. gauge drawing I have does not give cylinder sizes or hole pitchings, and other vital dimensions are missing.*

F.N.F. (Liverpool, 7).

You have probably discovered by this time that " L.B.S.C." has given all essential particulars of the 5-in. gauge engine in his serial, and the blue prints are now available from our Sales Department. It was not possible to publish all the essential dimensions for both engines at the same time; but " L.B.S.C." in this respect, has now met all his obligations in full !

HUMOUR IN THE WORKSHOP

By " Base Circle "

FORTUNATELY for us all, humour seems to flourish in the most unlikely places; but to an outsider, at least, there are probably few more unlikely places than the grim and forbidding premises where engineering is carried on. Yet even there, amidst the hustle and bustle, the rattle and clatter, and the constant urge to get more off in less time—even there from time to time some whimsical saying or absurd action will help to break the monotony of the daily round. The engineer, is, of course, a ready-witted and humorous fellow, but more often than not the humour is unconscious and the joke is seen by everybody but the perpetrator.

A good example of this kind of thing comes to mind. It was during the first world war and the shops were filled with dilutees—as the unskilled recruits were called at that time. One of them an ex-draper was in charge of the tool stores; a very opinionated and pompous little man he was, too. I was a young apprentice and my job at the time was to mill a ¼-in. keyway on a batch of shafts. The keyway had to be held to a limit of size to half a thousandth oversize—not by any means an easy task. The first cutter I got from the tool-store cut about one thousandth over the top limit in spite of very careful setting for truth. I took it back to the stores and reported this to the worthy draper asking him to let me try another cutter. He took the cutter, closed one eye, and holding the offending tool up to the light solemnly examined it. After due consideration he announced with the utmost gravity: " You're quite right, my lad, I can see the cutter's oversize." He was quite surprised at the guffaws of laughter with which this statement was received by the crowd round the stores window.

It was in the same shop that another wartime recruit went to the stores and asked for a 2-Ba tap pronouncing the Ba as in " Ba-Ba Black Sheep." That episode earned for him the nick-name of " the Sheep."

Another dilutee, this time a very elegant young lady, had been assembling small rheostats for some time. One day she ran out of screws, so she gaily went to the store with a sample and asked for some more of " the little twirly things."

Then there was the ex-grocer who worked at a bench, but could never get out of the habit of calling the bench " the counter."

The regular engineer, as I said, usually has a very keen eye for the funny side of things. For example, one turner whose machine happened to be situated in a particularly draughty place managed to scrounge a large piece of sheet steel which he erected as a draught screen. Next morning he arrived to find his screen labelled in large red letters: " The Iron Curtain."